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ECONOMIC ANALYSIS OF PUBLIC POLICY WITH RESPECT TO INTERNATIONAL TRADE: A CASE STUDY OF THE U.S. AEROSPACE INDUSTRY

A Dissertation Presented

By

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DEDICATION

This dissertation is dedicated to my beloving parents, who have made all this possible.

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ABSTRACT

Economic Analysis of Public Policy with Respect to International Trade; A Case Study of the U.S. Aerospace Industry

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International trade theory is based, in great part, upon the assumption that comparative advantage both causes and determines the pattern of international trade. But is comparative advantage really a cause of international trade, or a result? Or are international trade and comparative advantage conceptious results of more basic factors? Causality flowing from comparative advantage to trade has usually been taken for granted. The significance of the direction of causality can hardly be exaggerated, since the future patterns of international trade and the developmental strategy of many economies depends upon it.

An economy with high technology - high unit value exports is in a good position to improve the real income level of its people, since it can impute the rising production cost to its foreign customers. In the strange world of global protectionism, exporting, at a low price, is an unforgiveable sin, but charging an exorbitant price to foreign customer is praised as "fair competition." Under

the circumstances, an economy devoting its limited resources and manpower to the low technology - low unit value export industries is headed for self-defeat.

Comparative advantage theory, however, directs an economy to concentrate on industries it is relatively best at. This leads to a wider gap between developed economies and developing ones by further reinforcing the present state of comparative advantage. This is the terms of trade. What is correct to maintain the status quo in the international economy from a developed economy's perspective, may not be correct from a developing economy's perspective.

If comparative advantage theory were the universal guide, the prewar U.S. would have been better off by remaining a predominantly agricultural or at least a labor-intensive economy indefinitely, while Britain concentrated on technology-intensive industry such as the aircraft industry. But the U.S. aircraft industry took the opposite course. This defiance of the U.S. aircraft industry and government, turned out to be the cornerstone of American industrial leadership in the postwar period. Again Europe in the 1970's took a similar action in the development of the aerospace industry. These situations do not comfort with what comparative advantage theory directs.

The basic objective of this study is critically to examine the export pattern of the U.S. aerospace industry in light of international trade theory, to show that the real driving force of international trade is not comparative advantage but the will of entrepreneurs and Government to expand the market. The result was improving productivity and income levels.

The goals of industrial export, then, help fashion the state of comparative advantage. The mechanism is public policy. Comparative advantage seems to dictate the pattern of international trade, but only on the surface. In reality, comparative advantage is a result of the interaction between public policy and entrepreneurs' adaptability to a changing reality.

In a passive economy dominated by the trade of resource intensive commodities, comparative advantage seems especially rigid and inherent. But in the complex world we live in today, the patterns of trade is also determined by public policy. Factor endowment, which was stressed so much by the comparative advantage advocates, became less significant. A generally capital deficient economy, for instance, can have a capital-intensive industrial base by concentrating its resources.

All these factors lead to the hypotheses of this study:

1. Comparative advantage is not a factor which is

vested and fixed;

2. The state of comparative advantage is constantly changed by the interaction of public policy and the entrepreneurs' adaptability to their changing economic reality;
3. Comparative advantage is not a sufficient driving force of international trade but a necessary factor resulting from exogenous efforts;
4. The active driving force of international trade and the determinant of international trade pattern are the wills of entrepreneurs and government to improve the income and employment levels through market expansion.

In this analysis, it is proven that the hypotheses put forth are viable as far as the aerospace industries in the U.S. and Europe are concerned. Additional hypotheses are suggested which are concerned with the gains of international trade through the effects on the patterns of trade arising from government-industry cooperation in efforts. The hypotheses stress the particular differential effects of government policy on production and trade decisions.

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CHAPTER I. INTRODUCTION AND BACKGROUND

1. INTRODUCTION

It is said that who rules the sea rules the world. This aphorism may not fit perfectly to the complex world we live in today. Nevertheless, what may be true today, is that one who rules "space" may rule the world. This may be the inevitable consequence of the fact that, in abstract terms, any living organism strives for ever expanding periphery of its existence by whatever avilable means. The aerospace industry today provides one with the most advanced means for this purpose in a physical sense.

The advancement of the use of energy and speed has dictated the destiny of civilization. The Bronze civilization had come to an end as the Hittite learned to forge iron swords and European Feudalism disappeared as gunpowder was introduced from China. It is generally acknowledged that air superiority greatly influenced the outcome of World War II. However, we should not overlook the fact that the same iron and gunpowder used in warfare were also used in factories and quarries thus raising their productivity dramatically. Military bombers modified to commercial jet transports did the same thing by shrinking the globe into a fraction of what it used to be.

Aeronautical technology and nuclear energy are contemporary versions of gunpowder and iron. This is even more so because their consequences are not local but global. The advancement of aeronautical technology probably more than anything else led Great Britain to abandon her policy of isolationism and to join continental Europe. This also forced the United States to shift its traditional foreign policy away from the Monroe Doctrine. Furthermore, the size of the industry, compounded with its enormous impact on other industries, makes the understanding of its essence salient in any policy-making process.

Even leaving out the military implication of the aerospace industry, the economic importance of it can hardly be exaggerated. To be specific, industry sales of 28 billion dollars in 1975 represent 5.4 per cent of sales of durable goods, 2.6 per cent of manufacturing industry, and 1.9 per cent of gross national product.[1] But even more important than the mere number is the qualitative aspect of the industry. For instance, aerospace exports in 1975 reached a new high of 7.8 billion dollars. Due to the negligible size of aerospace imports, the net favorable trade balance of the industry is about 7 billion dollars. This is equivalent to 73.4 per cent of the total U.S. trade balance which was 9.6 billion dollars in 1975.[2] Thus it becomes clear that the strength of the dollar depends upon the performance of aerospace industry which is the single most important contributor to the trade surplus.

Another aspect to look into is the quality of employment. Although the total employment of 942,000 is only a fraction of the national work force of 84.1 million as of 1976, the number of scientists and engineers working in research and development programs amounts to 18.7 per cent of the national total of that group. In the sixties, when both the military services and the National Aeronautics and Space Administration(NASA) reached exceptionally high levels of research and development activity, the industry employed as many as 30 per cent of all U.S. research scientists and engineers.[3] Furthermore, by definition, research and development constantly reshape and expand the scope of our civilization. For example, items ranging from microwave ovens to supersonic transports, are the byproducts of the research and development efforts of this industry.

Thus it is crucial to have sound high technology industries such as the aerospace industry for any economy to become a truely viable one. This is particularly so in a time of global inflation since only an economy whose industries have either strategic value or a dominant position in the world market can improve the living standard of its people. Energy, aerospace, and food industries would be at the top of such a list. What such industries have in common is that the elasticities of demand for their products are less than in other industries. Thus it is easier for these industries to impute the rising production cost to their customers than it is in other industries. Furthermore, an economy with an export position in such industries can even enhance the living standard of its people through raising the prices of exports. For instance, the per capita income of OPEC members was increased greatly by raising oil prices. The U.S. aerospace industry also showed its outstanding ability in recycling petrodollars after the oil crises. However, the U.S. aerospace industry did not always occupy a preferred position. How did the aerospace industry attain its preferred position? The process by which the U.S. aerospace industry came to occupy its current position in the world market will be examined in this paper.

2. OBJECTIVES OF STUDY

The basic objective of the study is to scrutinize the export patterns of the U.S. aerospace industry in light of international trade theory. The core of international trade theory is based on the assumption that comparative advantage is the driving force of international trade and the determinant of the international trade pattern. The hypotheses of this study, however, are:

1. Comparative advantage is not a factor which is vested and fixed;

2. The state of comparative advantage is constantly changed by the interaction of the public-policy and the entrepreneurs' adaptability to their changing economic reality;
3. Comparative advantage is not a sufficient driving force of international trade but a necessary factor resulting from exogenous efforts;
4. The active driving force of international trade and the determinant of international trade pattern are the wills of entrepreneurs and government to improve the income and employment levels through market expansion.

In order to substantiate these hypotheses, the growth of the industry during the last three quarters of a century will be systematically analyzed in conjunction with U.S. public policy. By doing so this study will investigate the crucial role of the government in changing the state of comparative advantage between the U.S. and British aerospace industries.

The U.S. aerospace industry deserves attention in many aspects. It is not only the provider of the physical means of national defense, but also the largest contributor to the net balance of trade as well as the largest employer of scientists and engineers. Yet due to its unique composition of business, military, technology, and politics, few students have attempted to study this fascinating industry as a whole.[4] This may be due to the fact that science today has become much too specialized to tackle the task of analyzing this complex structure of the twentieth century. This study examines the aerospace industry from the perspectives of four distinctive factors which concurrently determine the development of the aerospace industry: technology, military, politics, and business.

Understanding the nature of the aerospace industry is essential to a proper comprehension of it and its consequential impact on the general economy: First, its product line is largely determined by Government needs and requirements which have been constantly changing in response to developments in domestic and international relations. It has therefore been acutely subject to variations in national policy and has simultaneously had to keep pace with a rapidly changing technology.

Second, the industry's products require continual advances in performance, thus constantly forcing the industry to expand the frontier of its technology. Consequently, the industry draws the largest share of the country's public and private expenditures on research and development. Thus, its impact on long-term growth in productivity through spill-over effects and the national economy is incalculable.

Third, due to the nature of its product, (i.e. weapon systems) the industry's foreign activity is subject to government regulation which is constantly changing. In international politics it is not unusual to see friends of the past become enemies of today or vice versa. Accordingly, foreign trade policy regarding weapon systems is unpredictable. However, since any industry must keep a steady team of scientists and engineers to seize a forthcoming opportunity, it is painful to follow this erratic guideline.

Finally, as the scale of a single project increases and the number of projects becomes fewer, winning or losing a single project becomes a matter of life or death for the company involved. Moreover, some projects may take seven to ten years from design to production while ever-increasing complexities require sophisticated system management. Thus aerospace companies are forced to do whatever is necessary to secure contracts. This inevitably brings about political factors in the course of development. Such considerations make the aerospace industry suited not only to quantitative analysis, but also to qualitative analysis.

The methodology of this study is mainly historical and exploratory. However, it is also concerned with suggesting some hypotheses which make the theory of international trade more consistent with reality and more explanatory of the course of historic adjustment in international trade pattern. In brief, this is a study of business history directed at examining the conceptual basis of international trade.

3. IMPLICATION OF STUDY

Up until World War II, the U.S. aircraft industry had to appeal to the government for protection from the European aircraft industry. However, it emerged as the largest industry in the world during the war. Even after the war it suffered from foreign challenge particularly from the British aircraft industry. Nevertheless, it was able to overcome the technological gap and to dominate the world market for the last three decades. In this process of growth, the supportive public policy of the various departments of the U.S. government played a critical role. Being both customer and patron of the industry, the U.S. government directed its destiny. On the other hand, the ineffectiveness and myopia of the British government, more than the internal problems of British aircraft industry, is blamed for her loss of the prewar marketshare in the world market.[5]

As this is being written, however, the British aircraft industry is struggling to regain her old glory through the transnational projects ardently promoted by various sets of European countries. Some of the well known collaborative projects are Concorde, Airbus, Jaguar, Multi Role Combat Aircraft(MRCA), and Martel air-to-ground missile projects. Whatever the outcome may be, this suggests that the public policy in general is a crucial determinant of the export pattern and the growth of the aerospace industry. Although, this may not be the case of every industry, it is likely to be true of any high technology-high value industry.

This observation may have a significant implication to the developing economies and their developmental strategies, since the comparative advantage theory has directed them to concentrate on low technology - low value industries while developed economies concentrate on high technology - high value industries. From the viewpoint of developing countries, this does nothing but reinforce the present foreign trade patterns and thus further widen the gap between the living standard of developed countries and that of developing countries.

But our thesis is that the state of comparative advantage is only the result of many external factors, and thus it is changeable through various public policy. This implies that an economy should not bind itself by the present state of comparative advantage in trading with others for comparative advantage is not the true cause of international trade. The true driving force of international trade is the will to expand the size of the market, thus raising the productivity and income level of a concerned economy. The state of comparative advantage is not vested or fixed as the traditional school preaches but results from, and is constantly changed by an active public policy.

The experience of the U.S. aerospace industry substantiates the hypotheses of this study. From predominantly agricultural economy the U.S. aerospace industry emerged as an economic giant of the twentieth century. If the comparative advantage advocates were right, the U.S. should have remained as an agricultural economy due to its vast fertile land, and weak high-technology intensive industrial base. But the U.S. was forced to develop its own with strong governmental support due to the last two World Wars and the subsequent Cold War with Soviet Russia. This turns out to be an indispensable asset for the U.S. in attaining both economic and political leadership in the postwar era. Thus the defiance to the traditional thought on international trade offers an opportunity to examine the validity of the hypotheses of this study.

4. BACKGROUND OF STUDY

Since the first usable aircraft was made by the Wright brothers in 1903 the progress of the aircraft industry has been upward, but only sporadically so. The first aircraft company was established by the Wright brothers in 1909, but was soon closed because of lack of demand. Not until the outbreak of World War I was the strategic value of aircraft recognized by the U.S. Consequently, the U.S. found itself totally unprepared. There were no combat aircraft in the U.S. capable of surviving aerial battle for aircraft were considered basically as a means of secondary transport. In the brief eighteen months of the war the U.S. tried desperately to catch up with the technology of its European counterparts. However, its effort was unsuccessful. Disruption after the war made the mess even worse because of slow commercial demand and the disposal of a huge military surplus. Consequently, in the early 1920's, the industry was struggling for a mere existence.

In 1925, the Morrow Board appointed by President Coolidge filed its report concerning the future of the aircraft industry and its effect on national security. This resulted in the Air Commerce Act, the Army Air Corps five-year program, and Navy five-year program into existence.[6] The report also provided, for the first time, the basis of a long term national air policy that brought a virtual rebirth to the industry. Within a few years U.S. aircraft were able to establish scores of world's records. But, in 1934, the industry was set back on its heels by the abrupt cancellation of the federal air-mail contracts. One scandal after another was featured by the mass media. Everyone concerned was preoccupied with cautiousness while the industry became troubled and depressed.[7]

With the military procurement interrupted, the aircraft industry expanded its exports. Toward the end of the thirties exports amounted to 70 percent of the total industry sales. Then came the Arms Embargo Act, of the F.D.R. administration, which cut off export outlets and again rocked the industry back on its heels.[8] Its recovery did not occur until the president's executive order permitting export was enacted.

Finally, the Lend-Lease Act of 1941 cleared the way for quantity exports to the Allies. Production jumped from 2,141 aircraft in 1939 to 6,086 in 1940 and to 19,290 in 1941.[9] Most of this production was for export. Foreign demand helped the U.S. aircraft industry expand its facilities and work-force, and led to its mass-production technology.

Therefore, in both wars aircraft exports preceded eventual wartime production. Fortunately, in both World Wars the U.S. had time for mobilization and for correcting the dificiencies in airframe production capacity. However, it is generally acknowledged that there will be no time given for gradual mobilization in the next war, due to the nature of warfare and the vacuum of power left by the European powers.[10]

For this reason, the U.S. government has realized that it needs an active aircraft industry as much as a standing Air Force. The production phase is as essential as research and development. The military has also learned that new weapons which are untested, underdeveloped, or only available in small quantities, have little consequence in the course of war. A good example of this was the German jet fighter. German research teams were far ahead of the Allies' counterpart in jet engine development and far ahead of their production capability. However, the first jet fighter, He-178, came out too late and in too small a quantity to affect the course of World War II. Had Germany's jet fighters been produced in a sufficient quantity in time, the war might have taken a different course, or at least would have been prolonged.

Two World Wars taught the U.S. government and military three things: First, there is no substitute for time in the research and development of a new aircraft. And the time required for development increases with the advancement of technology. Whereas the standard four-engined bomber of 1940 required 150,000 man-hours of research and development, the same type of Bomber in 1944 required 1.5 million manhours.[11] Accordingly, the time lag of development was extended from four years on the average which it took during World War II to the rate of eight years which it takes today.

Second, quantity production is essential to effective air power. Only a sufficient number of aircraft can have any strategic value, no matter how superior the aircrafts are. Of utmost concern, is the fact that mass production requires a steady demand from the public sector for business in time of peace.

Third, applied research and development requires a great amount of time and money. Therefore, it became obvious that the establishment of a long-range national research program must be integrated with the program of production. This requires a special working relationship among the government, the military, scientists, and industry.

Unlike the attitude of the government after World War I, the government now supported the development of the aerospace industry in every possible way after World War II. The aggravation of the Cold War further enhanced its support of the industry. The government-industry relationship became more of a partnership than a customer-producer relationship. Thus the military-industrial complex began to take shape.[12]

The launching of the U.S.-Soviet space race in the 1950's and the increasing military reliance upon missiles shifted the structure of the industry. A decisive consequence of the space race was a decrease in demand for military planes. There was some compensating increase in the output of civil aircraft and there were also exciting prospects in some other areas such as Vertical-Take-Off-and-Landing aircraft(VTOL), Short-Take-Off-and-Landing aircraft(STOL) and urban transportation. Nonetheless, military aircraft had always constituted the largest segment of the industry's business. Thus when this dropped off, the industry had to find an alternative. Of the many alternatives, going into missile production itself was the most feasible one. However, there is no compelling reason for missiles to be made by the aircraft industry. In some case electronic firms were more qualified to do so. Nevertheless, the aircraft industry, by adapting a new requirement of technology and the course of public policy, was successful in transforming itself into the aerospace industry.

The introduction of the jet engine also altered the market structure of the industry. Boeing's successful modification of the jet tanker, KC-135, into a commercial transport put it in a formidable position.[13] The jet transport also had a profound impact on the laymen's concept of the world as well as on Wall Street by adding dozens of new glamour stocks in the airline business. In 1968, the industry reached a record prosperity due to the Vietnem War, the ambitious space project, and the ever expanding commercial transport demand. But the end of the Vietnam War and the reduction of the space program coupled with soft demand in commercial transport and high inflation ignited by the oil crisis hit the industry hard.

The aerospace industry adapted itself to a new situation by expanding its export sector. By definition, trade deficit on one side means trade surplus on the other side. Thus the oil crisis in the rest of world implies a record surplus in the Organization of Petroleum Export Countries (OPEC) members. Aerospace products were precisely what OPEC wanted most. OPEC, with virtually unlimited financial resources, soon became the best customers of the U.S. aerospace industry. In 1975, the aerospace exports reached a new high of $7.8 billion with over $7 billion of net trade balance. This represents 73.4 percent of the net trade balance of this country.[14] But at this point another factor that clouds the future of the industry must be considered: the conflict of U.S. military and foreign policies with foreign trade.

Behind the record of upsurge and downswing was the industry's unique monopsonistic character; the U.S. government purchased over 60 percent of the total output. This industry heavily depends on the military procurement, subject to public policy. Yet history reveals that the U.S. had no consistent plan in peace time to maintain production levels, except years ago when the Morrow Board program(1926-

1931) was in effect.[15] On top of this, the unique nature of the industry as the producer of the most advanced weapon systems makes it subject to a close regulation by public policy in its foreign trade activities.

The federal government's contribution to the progress of the industry is substantial. Research work with public funding was vitally important in the advancement of aeronautical science and technology. Besides military procurement, the expenditure of public funds for airports, air traffic control and navigational aides, and the promotion of safety, economically stimulated the expansion of aviation and therefore of the industry. Hence public policy in both the military and foreign areas and entrepreneurs adapting themselves to these policies control the general pattern of progress in both domestic and foreign trade. Comparative advantage in foreign trade may have resulted from these activities, but not vice versa.

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CHAPTER II. REVIEW OF LITERATURE

1. INTRODUCTION

International trade theory rests on attempts to explain the causes and determinants of the patterns of international trade by comparative advantage. But is comparative advantage really a cause or simply a result of international trade? Although many theorists seem to take causality for granted, the importance of considering the matter can hardly be exaggerated since the future pattern of trade and the developmental strategy of an economy will depend upon it.

For instance if comparative advantage theory were correct, the prewar U.S. would have been better off by remaining a predominantly agricultural economy indefinitely while Britain concentrated on technology intensive industry such as the aircraft industry. Indeed this was the case until World War II. When the war broke out, the U.S. had to produce British models to equip its own Air Force. Numerous patents and research data liberally supplied by Britain were indispensable for the U.S. in catching up with the European aircraft industry. The only major advantage the U.S. aircraft industry had was that it was located far away from the bombing range of the Luftwaffe. Equally important was the fact that the U.S. government was willing to and was able to, generate on unprecedented mass demand of aircrafts in order to win the war.

By the end of the World War II, the U.S. aircraft industry emerged as the largest manufacturing industry of the world. Yet, it was still lacking in quality, and was not superior to the British aircraft industry. The first commercial jet transport, Comet was developed by the British, and Vickers and Armstrong were still dominating the postwar world market. The British aircraft industry was about four years ahead of the U.S. in technology[1] and many British models such as the Canberra were adapted as production models even after the war.[2]

The U.S. aircraft industry, however, had strong government support through a generous procurement policy which was further expanded as the Cold War became intensified. The technological base which was gained from military procurement was automatically transferred into the development of commercial aviation. This was culminated in Boeing's successful modification of the jet tanker, KC 135, into model 707. Eventually, the British aircraft industry was forced to retreat from long range jet transport. It was to the advantage of the U.S. aerospace industry that it started late, for it was able to learn from the mistakes which the British manufacturer had made.

Gradually, the U.S. aerospace industry replaced the British manufacturers in the world market. The comparative advantage theory suggests that a country should reinforce the present patterns of foreign trade in order to benefit most from trade. In reality, however, comparative advantage is a result rather than cause of trade. It is also local because the cost curve of any particular firm may not be identical to the cost curve of an industry. Thus it could be true that the most efficient firm in the least efficient economy is more efficient than the most efficient firm of the most efficient economy. Consequently, a firm's position in international market is not necessarily determined by the market position of the industry as a whole. Comparative advantage is then not a national economic phenomenon but a local phenomenon.

Other positive external factors such as government procurement policy and tax incentive more often than not affect the conditions of production and demand. New patterns of foreign trade emerge as the result of these. Therefore, instead of a comparative advantage theory we propose a dynamic externality theory. Even if the comparative advantage theory may be useful in defending the vested interest of the British aircraft industry, it is not useful in explaining the behavior of a country which strives for catching up with others as was the case of the U.S. in the 1940's.

This dynamic externality theory may not apply to every industry or every country but it certainly helps us understand the development strategy of the developing countries. The development of high technology - high unit value industry is crucial to any economy for improving the living standard of its people. The traditional comparative advantage theory directs us to obey the present pattern of foreign trade, thus further reinforcing the state of comparative advantage, and widening the income gap among countries. The dynamic externality theory, however, indicates that comparative advantage can be changed by public policy.

This purports to investigate the economic impact of public policy upon the growth of a technology industry, the U.S. aerospace industry in light of international trade theory. For this purpose, the major theories of international trade will be critically reviewed. Then the growth of the U.S. aerospace industry and the changing patterns of foreign trade will be analyzed with respect to the U.S. public policies.

Even if every exporting country has a comparative advantage over every importing countries for a specific product, it does not necessarily mean that comparative advantage caused the country to export that specific product. It may well be the other way around, or that a third factor which caused comparative advantage may have also caused export. For instance, since sun rays cause warm weather and dark shadow, there is a positive correlation between temperature and the intensity of the darkness of shadow. But this does not mean that higher temperature causes darker shadows or vice versa. In order to scrutinize this matter, we need further intuitive observations of the phenomena.

From Ricardo[3] onward, most of the international trade theorists have focused on the production and cost aspects of international trade. This culminated in the Heckscher-Ohlin theory[4] which is effectively challenged by Leontief.[5] Since then many critiques and defenses have been exchanged by the opponents and proponents of this theory. Meanwhile, many theorists have attempted to improve the traditional model by expanding it in both space and time dimensions. Yet all the attempts have been greatly hindered by poorly defined variables and many unrealistic key assumptions. In order to improve this theory, therefore, we need to examine the relevance of the assumptions since the ultimate value of a theory rests on its external relevance as well as internal consistency. At the same time, we need to clarify precisely definitions of the variables.

Unfortunately, one of the most important aspects of international trade, the income effect and other external factors have been largely neglected by the traditional theorists. The income effect is the effect of trade on the income expansion and accompanying multiplier-accelerator effect, as well as the distribution of income. In a sense, the income effect of international trade is even more crucial than the specialization of production due to price effect, because of its dynamic nature. Thus the author catagorized all the previous significant studies under three headings: Protectionism, price theory, and income theory. Some may think that this is a rather unusual classification. However, there is nothing sacrosanct about any classification.

Protectionism has never been acknowledged as a rigorous school. Yet it has such an amazing staying power that even today imposes a meaningful threat to the enhancement of international welfare. Also its argument has been constantly sharpened by an unceasing stream of patronized scholars. Even as this is being written President Carter is being pressed by the steel and shoe industries and labor, to cite a few, to restrict foreign imports. Thus even though many theorists fend protectionism to be an unfounded theory, it is important to examine it critically.

The first true scientific approach to international trade is price theory. This can be traced back to Adam Smith's absolute advantage theory. This has evolved to Ricardo's well known comparative advantage theory, which was actually first conceived by R. Torrens.[6] This is further developed by Heckscher, Ohlin, and Samuelson, but it has still remained a price theory. Its inability to explain the international economic phenomena has led to considerable criticism. Most of the criticisms, however, are limited in their scope to the price and production sides of international trade. Thus some people like, Wijnholds[7] lamented to the fact that "too much time has been already wasted in patching up a theory which is faulty in its very foundation."

The critical drift brought increasingly more attention to the income aspect of international trade. Yet most of contemporary economists, who were brought up in an affluent society, tend to take for granted this real driving force of international trade, which made the present affluence possible. Nevertheless, many, consciously and unconsciously, wrote about income effect and its implication to the national economy.

Although income theory explains the current international trade pattern better than price theory it still lacks an explanation of the active cause of it. This is due to the fact that it deals with the symptoms rather than the actual cause. A disease is not caused by high temperature but by a pathogenic agent. A high temperature is only one of the many symptoms of a disease. Thus if a doctor prescribes only according to the degree of a patient's temperature, he would not always diagnosis correctly.

In the same fashion, we should look into any economic phonemena in light of active causes rather than passive symptoms. In the real world, the true actor is Man. Consequently, his value system, mentality, physical dimension, and social institution direct the destiny of the world he lives in. In the real world these could converge into public policies ranging from military policy to tax structure. This study attempts to find the true driving force of international trade in actors rather than in symptoms. Therefore, it seems more appropriate to look into public policy which is the social embodiment of Man himself.

2. OVERVIEW

Most of the significant studies can be systematized in the following format:

Table 1. Theories of International Trade

Major Theories		Major Arthors
Protection-ism	Mercantilism	Jean Bodin (1530-96) Jean Colbert (1619-83) Thomas Mun (1571-1641) William Petty (1623-87)
	Unemployment Theory	Labor Unions all over the world

Major Theories			Major Arthors
Protection-ism	Infant Industry Theory		Alexander Hamilton (1757-1804) Frdrich List (1789-1804) B. Hildebrand (1812-1878) W. Roscher (1817-1894) K. Knies (1821-1898)
Price Theory	Absolute Advantage		Adam Smith (1723-1790) J.S. Mill (1806-1973)
	Comparative Advantage		R. Torrens (1780-1864) David Ricardo (1772-1833) David Hume (1711-1776) Francis Edgeworth (1845-1926) Alfred Marshall (1842-1924)
	Factor-Endowments		Eli Heckscher (1879-1952) Bertil Ohlin (1932) Paul Samuelson (1941) James Meade (1950) Wassily Leontief (1953)
	Revised Price Theory	Taste	S.B. Linder (1961)
		Economies of Scale	G.N.T. Hung (1968)
		Transpor-tation	M. Beckman (1955) Isard & Peck (1954)
		Competi-tion	H.G. Johnson (1967) I.B. Dravis (1956)
		Techno-logy	D. Keesing (1968) L.T. Wells (1968) Gruber (1967)

Major Theories		Major Arthors
Income Theory	Multiplier Accelerator Theory (Real Side)	Colin Clark (1938) Roy Harrod (1939) D.H. Robertson (1939) L.A. Metzler (1942) Fritz Machlup (1943) Joan Robinson (1947) J.J. Polak (1947) W. Stolper (1947) Kenichi Miyazawa (1960) Douglas North (1961) C.P. Kindleberger (1961) R.D. Wolff (1970)
	Balance of Trade Theory (Monetary Side)	J.M. Keynes (1929) August Losch (1930) Fritz Machlup (1930) Arnold Harberler (1950) S.S. Alexander (1952) H.G. Johnson (1956) Jan Tinbergen (1952) Paul Ellsworth (1950) A.J. Brown (1951)
	Terms of Trade	Gottfried Haberler (1949) R.E. Baldwin (1955) W.M. Corden (1957) Paul Prebisch (1963) Murray Demp (1956)

3. PROTECTIONISM

The progenitor of protectionism is mercantilism, which is the label given to the doctrines of nationstate in the period from the fifteenth to the eighteenth centuries. This emphasizes the importance of the trade surplus in securing precious metals, which are regarded as essential to national wealth and strength.

The essentials of this doctrine can be summarized in the following manner.*

1. a trade policy should be framed and executed in nationalistic scope;
2. the assessment of a policy was based on the net inflow of precious metals;
3. policy goal was to secure the largest possible trade surplus so that the quantity of precious metals can be increased;
4. high tariffs and all the possible means to control imports as well as direct promotion of exports by government authorities were used in order to attain trade surplus;
5. since all countries cannot attain trade surplus simultaneously, hostility amongst nations is inevitable.

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* later mercantilists (e.g. Steuart) have the coloration of classicists.

According to mercantilism, imports are a necessary evil and ought to be carried out only if they are:

1. essentials which cannot be produced domestically;
2. raw materials with high labor contents for eventual re-exports;
3. compensation for other country's imports from the concerned country.

Thus the implicit mercantilist ideal is zero import.

Even in France where mercantilism was most prominent during the fifteenth to eighteenth century, many worried that the severity of French import restrictions would result in other countries's retaliation. But Colbert persisted that only France alone, with her large population and domestic market, can produce the whole range of commodities, whereas no others could dispense with French commodities. Thus France should not worry about others' reaction to her protectionism.

Thomas Mun[8] advocated that gold export to buy goods which is to be re-exported later is desirable and necessary for the national interest in the long run. Also David Hume[9] pointed out that a trade surplus leads to an expansion of money supply and to an inflation which ultimately hampers exports and thus eliminates the trade surplus. The fever of protectionism subsided as more rational classical school gained momentum. Whenever domestic economy gets in trouble, however, the ghost of mercantilism haunts only to further aggravate the depression.[10]

Much of the neo-mercantilism (protectionism) argued by the labor unions all around the world is based on the protection of transitional unemployment which is necessary for any adjustment toward optimum allocation. But their goal is entrenched with self-defeating elements as well as being detrimental to the public interest in both the short run and the long run.

For instance, if the U.S. raises the current tariff rate of 10 per cent of shoes to 40 per cent as the International Trade Commission(ITC) recommended, 5,100 jobs will be saved on the assumption that labor union's claim is correct.[11] The ITC proposal would, however, add another $1 to the retail price of casual shoes made abroad resulting in a $500 million extra burden to the American consumers a year.[12] This means each shoe worker is subsidized with about $100,000 not considering the loss of reciprocal foreign demand which can only be financed by corresponding exports. Furthermore, this kind of misallocation of resources tends to decrease the efficiency of efficient sectors thus making them less competitive. Therefore, sound value system of economics based on rational assessment of the reality should be mobilized once again for the public interest.

4. PRICE THEORY

A. ABSOLUTE ADVANTAGE THEORY

This division of labor, according to Adam Smith[15], can benefit all the concerned parties on an international scale as well as on a national scale. To be benefited by absolute advantage, every country should concentrate on what it can produce more economically than others and trade for the goods which others produce at less cost. Thus, international trade enhances the utilization of unused factors of production. John Stuart Mill [14] later called this "Vent of Surplus" theory of international trade.

B. COMPARATIVE ADVANTAGE THEORY

David Ricardo[15] went one step further by stating that it is not the absolute, but the comparative advantages which cause and determine the patterns of international trade. Even if a country were absolutely advantageous or disadvantageous in producing everything, it would still be benefited to concentrate on the production of the goods which are comparatively advantageous.

His implicit assumptions are followed:

1. no economies of scale and no technological change;
2. fixed factor supply and full employment;
3. no transportation cost and free trade;
4. the costs are determined by the amount of labor

put into the product;

5. perfect mobility of production factors domestically and perfect immobility internationally.

Then he goes on to the familiar example of England and Portugal.

Table 2. Unit Cost of Production Before Trade (Men a year)

Products	England	Portugal
Wine (a gallon)	120	80
Cloth (a yard)	100	90

Source: The Works and Correspondence of David Ricardo, London, Sraff (ed.), 1952, Vol. 1, pp. 135-136.

In England a gallon of wine costs 120 men for one year and a yard of cloth 100, while in Portugal the real cost of wine and cloth amounts to 80 and 90 men for a year respectively. Portugal thus has an absolute advantage over England in the production of either commodity, but a comparatively greater advantage in the production of wine since 80/120 is smaller than 90/100. The pre-trade price ratio of wine and cloth would be proportional to their costs of production, that is, 120 : 100 in England and 80 : 90 in Portugal. Thus cloth is comparatively cheap in England and wine is comparatively cheap in Portugal.

After trade is opened between the two countries, England will export cloth and import wine. Ignoring transport costs, an equilibrium price will result which will lie between the limits of 120 : 100. If England now specializes in the porduction of cloth and transfers labor from agriculture into industry, it can produce 1.2 units of cloth for each unit of wine, which it no longer produces. These units of cloth now can be exchanged for 1.2 units of imported wine from Portugal. Through trade, England will gain extra 0.2 units of wine for each unit of cloth exported. Thus the same quantity of goods produced could now be procured at lower real cost.

Accordingly, despite that Portugal produces both wine and cloth more efficiently, she would benefit by concentrating on wine production and importing cloth from England. For England, even though she produces less efficiently than Portugal in both wine and cloth, she can still benefit by concentrating on cloth production and trading with Portugal. This economic justification of free trade is probably the most significant contribution of the classical school.

On the basis of prewar statistics on labor productivity in the the U.S. and Britain, McDougall[16] attempted to assess the theory. He examined the productivity in twenty-five industries and their exports to the third countries. His finding upheld the theory of comparative advantage with regard to the U.S. and British trade with others.

Bhagwati,[17] however, refutes the argument on the basis that correlation coefficients are insignificant and labor productivity is not datum in the sense that production functions are. Further weakness is that data on labor productivity are unaccompanied by any explanation of why the labor productivity is what it is and how it may be expected to change. Moreover, even if we could predict changes in labor productivity, we could not tell that the pattern of trade would change in a specified manner.

In the two-commodity case, constant comparative costs merely set the limits between which the ratio of international trade will fall. Their exact location will be determined by the interplay of the forces of demand and supply. This is known as the theory of international value, which was conceived by John Stuart Mill. Mill developed the theory of the import demand of country in terms of its own exports. In this context, he employed the concept of demand elasticity which has become widely used by many contemporary theorists. He also considered the concept of multiple equilibria, as well as economic consequences of tariff under different elasticities of demand.

Marshall further developed the theory of international value by introducing the concept of reciprocal demand and supply curves. "Reciprocal" here means that the demand curve of country A for the products of country B is simultaneously A's supply curve of its own exports. By this he attempts to derive a general equilibrium in international trade. Each point along such a curve is in effect a possible point of equilibrium and each movement along the curve presupposes that the economy of the concerned country has adapted itself to the new equilibrium situation.

The classical theory of comparative cost, nevertheless, contains a considerable amount of vulnerability. First, although some degree of arbitrary assumptions are generally accepted practice of model building, (inherent nature of theory construction) there are too many unrealistic fundamantal assumptions. For instance, transportation costs seriously impinge upon comparative advantage. Also, once the two-factor, two-country, and two-commodity assumptions are relaxed, the patterns of trade based on the comparative advantage can no longer hold. Second, labor costs are not identical throughout a country and are even more so internationally. Labor is not homogeneous and indeed this is one of the causes of international trade occurring. Third, this does not tell us about the exchange ratio itself or about the actual quantities traded, because it ignores the demand side of international trade. Finally, no allowance is made for income change or technology and resources, thus the analysis is of static nature.

Despite many deficiencies, the doctrine of comparative advantage has enjoyed unparalleled longevity compared with other economic theories. We are not sure whether this is a favorable or unfavorable symptom for the advancement of the science. Probably one of the reasons why there are few controversies is that variables are unrealistic and unquantifiable, thus untestable. Yet it has such strong intuitive appeal that it is rather difficult to refute.

C. THE HECKSCHER-OHLIN THEORY

The classical theory of international trade was successful in explaining differences in the relative share of different countries in terms of the different productivity of labor in the relevant industries. But the existence of the differences in comparative costs was left unexplained. Heckscher first attempted to explain this by the different factor endowments of the different countries. The theory was significantly elaborated by Ohlin, but owes a great deal to Samuelson for its analytical techniques and propositions.

Heckscher-Ohlin theory adapts most of the assumptions employed by comparative advantage theory except the following:

1. it deals with production in terms of money cost instead of real cost. Thus it is no longer binded by the labor theory of value;

2. two factors of production instead of one are used;
3. for a given commodity, the same production function, homogeneous in the first degree, is used in all countries. Thus, a given change in all inputs results in an equal change in output;
4. the production function is governed by the law of constant returns to scale;
5. the number of factors is not greater than the number of commodities;
6. pure competition rules throughout.

Under these assumptions, international trade will occur as long as there are differences in the relative price ratios of domestic goods among the countries. Suppose countries A and B endowed with fixed quantities of two factors of production, labor(L) and capital(K) produce commodities X and Y. Assume that A is relatively labor abundant B is capital abundant on the basis of the physical definition of factor abundance. Finally assume that commodity X is labor intensive relative to Y for all factor-price ratios.

If the two countries produced the two commodities in the same proportion, the following equation held:

$$\frac{Q_x \text{ in A}}{Q_y \text{ in A}} = \frac{Q_x \text{ in B}}{Q_y \text{ in B}},$$

where Q is output. Because of different factor endowments, commodity X would be relatively cheaper in A than in B:

$$\frac{P_x \text{ in A}}{P_y \text{ in A}} < \frac{P_x \text{ in B}}{P_y \text{ in B}}, \text{ where P is price.}$$

Alternatively, at the same relative commodity prices, A would be producing relatively more X than Y compared with B. Thus following inequality would hold:

$$\frac{Q_x \text{ in A}}{Q_y \text{ in A}} > \frac{Q_x \text{ in B}}{Q_y \text{ in B}}$$

Given any factor price ratio (i.e., w/r), therefore, the optimum coefficients of production can be determined. This can be done by determining the points on the unit isoquants of X and Y where the absolute value of the slope of each isoquant is equal to the given ratio w/r. The coordinates of these points are the optimum coefficients of production. Assume that these coefficients are a_{lx}, a_{ly}, a_{kx}, and a_{ky}, where the first subscript indicates the factor and the second the commodity. These coefficients are common to both countries because of the assumption of identical production function.

Since it has been assumed that X is labor intensive relative to Y, the following inequality must also be satisfied:

$$\frac{a_{lx}}{a_{kx}} \, / \, \frac{a_{ly}}{a_{ky}}$$

The commodity-price ratio is given by

$$\frac{P_x}{P_y} = \frac{(w/r)(a_{lx} + a_{kx})}{(w/r)(a_{ly} + a_{ky})} .$$

Finally, for full employment it is required that the following two equations be satisfied:

$$a_{lx}\, X + a_{ly}\, y = L,$$

$$a_{kx}\, X + a_{ky}\, y = K$$

where L and K indicate overall factor endowments. Solving the above equations for X and Y, we get

$$X = \frac{1}{A}\,(L\, a_{ky} - K\, a_{ly}),$$

$$Y = \frac{1}{A}\,(K\, a_{lx} - L\, a_{kx}),$$

where $A = a_{lx}\, a_{ky} - a_{ly}\, a_{ky}$.

Consider the following ratio:

$$\frac{X}{Y} = \frac{L\, a_{ky} - K\, a_{ly}}{K\, a_{lx} - L\, a_{kx}} = \frac{(L/K)\, a_{ky} - a_{ly}}{a_{lx} - (L/K)\, a_{kx}}$$

This can be simplified to

$$\frac{X}{Y} = C\,\frac{R - R_y}{R_x - R} > 0,$$

where $C = \frac{a_{ky}}{a_{kx}}$, $R = \frac{L}{X}$, $R_x = \frac{a_{lx}}{a_{kx}}$, $R_y = \frac{a_{ly}}{a_{ky}}$.

The right-hand side of the above equation is necessarily positive because R is a weight average of R_x and R_y.

Accordingly, R must necessarily lie between R_x and R_y, a fundamental property of weighted averages. Hence both the numerator and denominator of the right-hand side of the above equation are positive.

Differentiating the ratio X/Y with respect to R, we get

$$\frac{d\,(X/Y)}{dR} = C\,\frac{R_x - R_y}{(R_x - R)^2}\,.$$

The sign of this derivative coincides with the sign of the difference $R_x - R_y$. Since, by assumption, $0 < R_y < R_x$, the derivative of X/Y with respect to R must be positive. This means that the higher the value of R, the higher the value of the ratio X/Y. Since R is assumed to be higher in A than in B, at the same relative factor and commodity prices, A is producing more X per unit of Y than B. This process continues until the price ratio is equalized in both countries.

The theory has an intuitive appeal, but it calls for some qualifications. First, the factors of production are not homogeneous. The quality of labor as well as the nature of capital structure are significantly different interfirm and internationally. Also capital goods may not be substitutable to labor and vice versa. The production of manufactured goods, owing to reduced transportation costs, is no longer so confined by factor endowment as it used to be. For example, Japan, with small deposits of iron ore, produces more steel than any other country. Manufactured commodities constitute more than seventy per cent of the total international trade so that the Heckscher-Ohlin theory does not explain all international trade.

Second, as in the case of classical theory, the Heckscher-Ohlin theory commits the serious fallacy of composition. This is probably due to the social scientists' general affinity to the natural science's neat theoretical framework and its precise prescription. The comparative advantage theory is built on the assumptions which are unrealistic and yet so fundamental to the argument. For instance, it is built on two-factor, two-commodity, and two-country assumptions. Then with little modification, it is extended to a general model. But three is not just one more than two always. Three may be an entirely new entity. Transitivity needs not apply to social phenomena. Therefore, social science may not fit to the same methodology as that of the natural science.

Third, production techniques are not the same in all areas. Many goods can be produced in different factor-intensive ways, but at similar costs. Fixed overhead cost along with expansion of market will inevitably lead to lower marginal cost; economies of scale. There may be diseconomies of scale on a factory level technologically, but not on a company level which is the unit of the decision-making in international trade. The company would invest in a second factory if the first ran into increasing costs. Relinquishing this assumption will thus, make the Heckscher-Ohlin theory as useful as salt without savor.

Finally, although all the theoretical models are based on unrealistic assumptions by definition, there is a limit in its arbitrariness. Once any assumptions cross this limit, the theoretical model can never be mended to have even a slightest relevance to real world. In this regard, Heckscher-Ohlin theorem, no matter how logically consistent it may be, cannot have external relevance. For instance, the inclusion of public policy factor may change all other variables not in a matter of degree but of quality. All the economic models are based on the assumption that Man behaves rationally in economic sense (i.e. profit maximization). But economically rational behavior may not necessarily be politically rational behavior and vice versa. Specifically, an economically irrational public policy often turns out to be politically or militarily rational one. Thus combining these two contradicting factor without proper thought would grossly distort the reality. Accordingly, this study focuses on the fundamental problems raised by unrealistic assumptions rather than elaborating the previous model.

The Stolper-Samuelson[18] theory has stood up a little better, although it too depends on a whole set of unrealistic assumptions. It has always been realized that tariff affect the distribution of income. While the country as a whole loses from a tariff, particular sectors may gain. Stolper and Samuelson showed that it is possible for a sector to gain absolutely as well as relatively from a tariff, independent of the consumption pattern and therefore not involving an index-number problem.

The core of argument is that a tariff will raise the real income of a country's scarce factor because:

1. protection increases the relative price of importable goods;
2. an increase in the relative price of good increases the real income of the factor used intensively in its production;
3. the importable good is intensive in the use of the factor which is scarce domestically.

Metzler[19] pointed out that protection may not increase the price of the importable good, since it may improve the terms of trade sufficiently to shift the terms of trade in favor of exports. The necessary condition is that elastidity of demand for exports is less than the domestic marginal propensity to consume for exportable goods. Thus, a necessary condition for the perverse Metzler result is that the export demand elasticity is less than unity.

Several economists have made efforts to explore the implications for the factor-price equalization theorem of the existence of more than two countries, goods, and factors. They have rightly felt that an answer to this question was an indispensable first step in deciding whether the theorem might have any empirical significance.

The effect of multiple countries on the analysis, other variables held constant, has been found to pose no problem. Both Tinbergen and Meade have argued that adding more countries merely adds an equal number of equations and unknowns to the equation system.[20] The determinateness of the system, and the conclusion that prices of comparable factors will be equalized by trade, are not affected. Tinbergen, a Nobel laureate along with Ohlin and Meade, points out, though, that the assumption that no country will specialize completely is more and more likely to be violated as we go on adding countries with divergent factor endowments, and "the equalisation of factor prices will only exist as long as not one of the countries is forced - by its data in connection with those of the production functions and the price ratio - to specialise."[21]

But perhaps Tinbergen's statement needs some qualification. Consider a multi-country model in which there exists, at the equilibrium position for the system, a subset of countries each of which continues to produce all commodities included in the system. Given all the other assumptions attaching to the theorem, factor prices will be equalized among this subset of countries. In general, however, factor prices will not be equalized among specialized countries, or between specialized and nonspecialized.

The more difficult problems involved in extending the theorem to cases of different numbers of goods and factors have been dealt with by means of complete systems by Tinbergen and Meade.[22] The most basic conclusion to arise from these efforts is that the factor-price equalization theorem holds for all cases in which the numbers of factors and goods are identical. When they become unequal, however, it makes considerable difference for the result whether the quantity of factors or the quantity of goods is greater. Suppose that in a two-country model, with n goods and m factors of production, we take international prices as fixed and given by international demand conditions. Then the relevant equations reduce to the following for each country:

$$1 = x_i \left(\frac{a_{i1}}{x_i}, \ldots, \frac{a_{im}}{x_i} \right), \qquad (i = 1, \ldots, n)$$

$$w_j = p_i \;\; x_i(a_{i1}, \ldots, a_{im}) / \, a_{ij} \qquad (i = 1, \ldots, n; \; j = 1, \ldots, m)$$

These two sets of equations give, respectively, the output of each commodity as a function of the quantities of all inputs and the wage of each factor as its (identical) marginal value productivity in each industry. The a_{ij}'s are input quantities, the x_i's outputs, the w_j's factor prices, and p_i's product prices. There are nm + m equations to determine nm + m variables, the w_j, and the a_{ij}. Obviously, they will just suffice for this purpose if n equals m.[23] If m is greater than n, the theorem will entirely fail to hold. No longer can all of the a_{ij} and w_j be determined from given international prices and production functions; the condition must be added that the quantities of factors available are fully employed.

This method of rendering such a model determinate is quite logical; given all international prices, it is intuitively clear that we can deduce the allocation of production and factor employment once we have information on the nation's total factor supplies. Specifically, we add to the two sets of equations above another set in the form

$$\Sigma_i A_{ij} = a_{ij}x_i + a_{2j}x_2 + \ldots + a_{nj}x_n = A_j,$$

requiring that factor markets be cleared. There are m equations in this form containing n new unknowns, the x_i's. The (m - n) underdeterminacy is just offset. But different quantities of factors in different countries (so long as the differences are not governed wholly by a single proportionality factor) will influence the dependent variables listed above, rendering factor-price equalization no longer likely.[24]

Where the number of goods exceeds the number of factors ($n > m$), the matter gets more complicated. Tinbergen, examining the equation system describing such a situation, found it to be partly underdetermined and partly overdetermined, therefore, in general, indeterminate. His conclusion was that specialization would as a rule be necessary, and "this no longer warrants the equality of factor prices."[25] Meade disagreed with this conclusion, and Tinbergen himself participated in the amending process.

Meade showed that a subset of equations in the model Tinbergen used is not overdetermined, but rather appears exactly determined. That is, it seems as if all prices and factor proportions are determined by supply conditions alone. When the system is reformulated, it does indeed appear that there is one degree of freedom within the subset. The economic meaning of this, Meade contended, is that demand conditions are necessary to specify one relative price relationship in the model, "but for the rest they determine only the amounts of the various products which will be consumed." Assuming throughout that none of the three products is produced in only one country, Meade holds that the essence of the indeterminacy of the system is the absolute size of the three industries within each of the two countries.[26]

D. CONTEMPORARY PRICE THEORIES

Actually most of the contemporary price theories are partially adjusted versions of the Heckscher-Ohlin theory. Leontief,[27] on the basis of his input-output table, examines how much capital and labor are required in order to produce one million dollars in the export industries and in the import competition industries in the U.S. If the Heckscher-Ohlin theory is correct, the U.S. which is presumably more capital abundant than the rest of the world, would export capital-intensive goods and import labor-intensive goods. Leontief's results are summarized in the following table:

Table 3. Factor Requirements of the U.S. Exports and Imports Replacements
(per million dollars of output of average 1947 composition)

Factors	1947		1951	
	export	import	export	import
Capital 1947 $(1,000)	2,551	3,091	2,257	2,303
Labor men year	181	170	174	168

Source: Leontief, Wassily. "Domestic Production and Foreign Trade: the American Capital Position Re-examined." Economia Internazionale, February, 1954. Caves & Johnson, Readings in International Economics, Homewood, Irwin, 1968, pp. 510-519.

The above table indicates that capital ratio of imports to exports for 1947 is 1.30 and that for 1951 is 1.11. This means that imports are more capital-intensive than the goods exported by the U.S. This contradicts the Heckscher-Ohlin theory and caused a great deal of concern among economists, widely known as the Leontief's paradox. Leontief himself conjectured that this may be due to the fact that American workers are three times more efficient that of the counterparts in the rest of the world.[28] Thus, if the labor were measured in terms of efficiency units, then the U.S. will be more labor abundant than the rest of the world.

Although Leontief's contention reveals a very interesting point, it is still an open question as to how we can prove that the American workers are three times more efficient than the workers in the rest of the world. For example, comparing the sales per employee for the 500 largest industrials in the U.S. and that of Japan, Japanese workers were more productive than the u.S. counterparts. Assets per employee are also higher in Japan than the U.S. Findings are summarized in the following table 4.

Although the number of the corporations is very limited, their combined sales represent about the half of the gross national products of each country. Also double counting problems impose some qualifications, but we can still safely project that Leontief's conjecture is somewhat insecurely founded. A more important aspect of the

Table 4. The 500 Largest Industrials in the U.S. and Japan (1975)

	U.S.	Japan
Total Sales ($ billion)	865.2	204.7
Total Profits ($ billion) (after-tax)	37.8	2.1
Total Assets ($ billion)	668.5	215.5
Total Employees (million)	14.4	2.7
Sales Per Employee	60,035.0	76,893.0
Assets Per Employee	46,383.0	80,937.0
Profits Per Employee	2,626.0	774.0

Source: Compiled from The President Directory, Diamond-Time Co. Tokyo, 1977, pp. 24-48; Fortune, May 1976, pp. 316-341.

study, however, is that it rufutes one of the key assumptions underlying the Heckscher-Ohlin theory: homogeneous labor.

Following the Leontief's paradox, many economists have attempted to rectify the theory from various perspectives. One of them is Linder[29] who states that the basis of exports is the satisfaction of domestic needs; goods are produced for the domestic market first and only after that for the foreign market. Since domestic demand is determined by income, exports normally go to countries with a comparable standard of living. This is contrary to the countries with different factor endowments.

Kravis[30] suggests that in the U.S. government tends to shut out imports that could be produced domestically although at much higher cost. His contention is that the determinants of the pattern of trade is availability or supply elasticities. "In short, it is the elasticity of supply abroad and its elasticity at home that give rise to this import trade, not the relative capital or labor requirements of the products."[31]

Availability depends partially upon factor endowments, although technological progress and product differentiation shape the pattern of trade. By treating natural resources factor of production as the principal determinant of trade Linder has narrowed down the Heckscher-Ohlin theory, in spite of the fact that this is more realistic than Leontief's conception.

Many theorists contend that technological changes explain the pattern of trade. Once an invention is perfected, the concerned country has a monopoly power over the market. As mass-production process is processed, the buyers become increasingly price-conscious. In this phase the production technique may be extended to other countries. Imitation by other countries terminates the technological lead and, through lower production costs and product differentiation, they even export to the country where the invention is originated. We have witnessed this kind of product cycle happening in the electronic, computer, and copying machine industries as well as in automobile industry.

Along this line of thought, Hoffmeyer[32] states that the U.S. exports of research-intensive goods increased much faster than its exports of other goods. The respective ratios are 20 : 3 for the period between 1910-14 and 1953-59 and 5 : 1.7 for the period between 1926-30 and 1953-59. Hafbarer[33] thinks that the technological lag, along with the economies of scale, caused the pattern of international trade in synthetic chemical industry. Keesing[34] also believes that there is a strong correlation between research and development intensity in the U.S. industries and their export performance.

5. INCOME THEORY

A theory no matter how ill-conceived it is, tends not to be destroyed by intermittent criticisms, but is usually replaced by a better theory. The Heckscher-Ohlin theory is no exception. This theory may explain nineteenth century international trade in which primary commodities played a predominant role. But things have changed as a result of the reduced transportation costs and constantly changing structure of trade resulting from industrialization. Accordingly, factor endowments have become less significant than they were in the last century.

Many other forces affect price differences - demand conditions, economies of scale, technology, and differing production functions. Indeed we are living in a world of substantially arbitrary and inflexible price structures, of planned economies at the various levels, and of omnipotent labor unions. The Heckscher-Ohlin theory is by no means relevant for such a world.

Furthermore, even if relevancy if improved, Heckscher-Ohlin theory would still suffer from its neglect of the demand and income aspects of international trade. Production is a necessary but not sufficient condition for international trade to occur, because effective demand, not factor endowment, is the generator of actual international trade. Failure to see this is precisely what plagued neoclassical economists in explaining the chronic depression in 1920's. Although Galbraith among a few others, emphasizes the large corporation's ability to generate the demand for its own products through product differentiation, demand creation still remains a limited phenomenon of oligapolistic markets.[35] The essence of business, as Henry Kaiser once said, is basically finding the demand and filling it. Failing to do so would only result in bankruptcy. In the long run, therefore, demand dictates supply rather than the other way around, because production cannot be sustained indefinitely at the absence of an actual effective demand.

The income effect is dynamic in contrast to the static nature of the price theory. Income generated by exports is further expanded through the multiplier-accelerator effects. New demand in both consumption and investment sectors created by larger income, which is in return generated by exports, activates the potential imports of an economy. When there are more than two hundred economies instead of two, these multiplier-accelerator effects can be amplified in much larger magnitude, as long as the concerned countries are not over-anxious to attain the instant balance of bilateral trade.

Moreover, even if there is no comparative advantage between two countries, international trade will still generate higher income and more employment via this multiplier-accelerator effects than if there were no trade. For example, there is no comparative advantage whatsoever between country A and B, yet an ambitious entrepreneur of industry X in country Y perceived potential opportunity in sales expansion through exports. As a consequence of export, income of the country A will be expanded and also factors of production will be reallocated in favor of industry X. This successful sector in the economy bids up the factor prices so that the other passive industry will be declining. This gives country B, which is strained for foreign exchange, a better chance to export Y to country A. Therefore, comparative advantage emerges as a result of international trade, rather than as a cause of it.

The implication of this argument is that there is no such a thing as rigid, inherent comparative advantage or disadvantage in the pattern of international trade. Thus economic development policy through export expansion should not be shackled by any presupposed, fixed comparative cost theory. Comparative advantage is a rather flexible and resulting effect of international trade. Consequently, a country should pay more attention to the income effect of international trade than to price effects which are too partial to determine the patterns of trade.

The multiplier-accelerator effects, however, can be activated only when exports are linked to investment by importing producer goods which will further enhance the productivity of an economy. Unless these are activated, the trade effect on income growth remains minimal. That is why mere linkage of exports to economic development failed to explain the slow growth of the economies which have high export growth rates such as in Rwanda, Upper Volta, etc.

On the other hand, all of the developed countries, without exception, attained the present income level through a rapid export expansion either during the nineteenth or early twentieth century. As Robertson[36] indicated, trade was an "engine of growth" in the last century. This means that trade is not only a means of optimum resource allocation, but also a vehicle of expanding income. Then what caused this disparity? The constant ploughing-back of the income generated by exports and resulting multiplier-accelerator effects made the difference. Thus it is not surprising to find that no single developed economy was developed by direct foreign investment and foreign aid which do not accompany this constant ploughing-back of income. Also this explains why the countries, whose high export growth was attained by foreign direct investment, could not sustain high economic growth rate.

The theories of income effect of international trade can be further divided into growth theory, balance of payment theory, and terms of trade theory. The monetary side of international trade is represented by balance of trade and the terms of trade theory. The real side of international trade is viewed by growth theory or multiplier-accelerator theory.

A. GROWTH THEORY (MULTIPLIER-ACCELERATOR THEORY)

The foreign trade multiplier theory grew out of the Keynesian system but was not developed by Keynes himself. The dynamic version of the foreign trade multiplier is primarily the work of Machlup[37] and Metzler.[38] On the other hand, Harrod[39] and Meade[40] developed the static version. Static theory describes and compares equilibrium conditions at different times. Dynamic theory examines the transition from one equilibrium to another.

The assumptions of the Machlup's theory are following:

1. marginal costs are constant, thus prices remain unchanged;
2. financing of grade deficit is unlimited;
3. the marginal propensity to import and the marginal propenisty to consume are constant;
4. imports during the period $t(M_t)$ depend upon the income of the preceeding period (Y_{t-1}):

   $m = M_t \,/\, Y_{t-1}.$

In an open economy, import as well as saving is considered as leakage. Thus, just like investment multiplier in a closed economy, trade multiplier becomes

$$\frac{1}{s + m} = \frac{1}{1 - c}$$

where $s = 1 - c$ being the marginal propensity to save and m the marginal propensity to import. Suppose country A's marginal propensity to save is 0.2 in a closed economy then multiplier would 5. If the marginal propensity to import is .13 in an open economy, then multiplier will be reduced to 3 since a greater portion of investment expenditures will leak out of national income system than before.

If, however, these phenomena are cumulated throughout the world, the money leaked abroad will flow back into the country in much greater mahnitude. As rule, the actual magnitude depends upon foreign propensity to consume and marginal propensity to import. The reason is that the rest of the world's economy will be stimulated by the increase of A's demand and will therefore, in return import more from country A. Hence the true multiplier will be greater than the foreign trade multiplier which ignores these indirect effects. This reciprocal demand is precisely the underlying idea of the Marshall Plan, although real intention is more complicated by political consideration. The result was, as we all know, a most striking success. This implies some future course of global scale mutual prosperity through open economic policy despite many hinderances.

B. BALANCE OF TRADE THEORY

In general there are three ways to restore the balance of trade;

1. gold transfer;
2. fluctuating exchange rate;
3. direct exchange control and regulation of international trade.

Under the gold standard system, only domestic price and wage levels change. Under flexible exchange rate system, domestic price and wage levels remain unchanged while exchange rate adjusts itself. The relative prices of diffeeent commodities, however, will have to change in the process of adjustment, even if the general price level remains unchanged. Most of the balance of trade theories, nevertheless, focus on the adjustment mechanism under the flexible exchange rate system.

Haberler[41] develops an excellent partial-equilibrium anlysis. The key concept is the marginal propensity to import, $\Delta M/\Delta Y$, which is analogous to the Keynes' marginal propensity to consume. The income elasticity of demand for imports (E) will be denoted in the following way:

$$E = \frac{\Delta M / \Delta Y}{M / Y} = \frac{\Delta M}{\Delta Y} \cdot \frac{Y}{M}$$

where M/Y is the average propensity to import.

Suppose that the marginal propensity to import of the country A (MPI_a) is 1/3 and that of B (MPI_b) is 2/3. If deficit arised in A, A will import less by 1/3 of the amount of deficit and B more by 2/3 of the amount of trade surplus. Thus income effects are just enough to restore equilibrium. If $MPI_a + MPI_b < 1$, however, the income effects are too weak to reestablish equilibrium in the balance of payments. On the other hand, if $MPI_a + MPI_b > 1$, then income effects are so strong that the deficit will be overcompensated eventually.

Therefore, if the sum of the country's demand for imports and the corresponding foreign demand for its exports is greater than unity, then a currency devaluation can improve the balance of payments. If this sum is smaller than unity, then devaluation will only worsen the balance of payments.

The contraries are not rare. The reason is that there is often great danger that the favorable effects of a devaluation of the balance of payments will be jeopardized by incautious wage and monetary policies. Pressure in this direction is so strong because, under full employment, improvement in the balance of payments is necessarily accompanied by a painful reduction in consumption and investment. Under this circumstamce, government tends to alleviate recession and the transitional unemployment, by means of generous fiscal and monetary policies.

6. CONCLUSION AND HYPOTHESES

The development of international trade theories can be summed up under the three distinctive lines of thought: protectionism, price theory, and income theory. Modern protectionism can be subclassified into unemployment argument of the trade unions of declining industries in the developed countries and infant industries argument of less developed countries.

The first thought on the price theory can be traced back to Adam Smith's absolute advantage. Comparative advantage expanded its horizon by stating that even if a country has an absolutely advantageous or disadvantageous in producing both goods, international trade can still be beneficial to all the trading partners. This became a powerful driving force for free trade.

The Heckscher-Ohlin theory further elaborated the international price theory by explaining the existence of the different comparative costs in terms of different factor endowments. This, however, has serious drawbacks. It is unrealistic and neglects the aspects of income and demand of international trade. This calls for more general theory based on realistic assumptions.

The income theory fills this need neatly. First, income effect is dynamic in nature, contrast to the static nature of price theory. Second, this does not require comparative advantage to be a prelude to international trade. Third, income theory explains the real international trade phenomena far better than price theory does. Last, income theory is less bound by unrealistic assumptions than price theory. Therefore, this income theory is qualified to be further developed into a fuller general theory of international trade. But it still lacks the quality of applicability, since it left out consumer taste, conditions of production, and especially public policy as variables.

Public policy requires special attention because it changes not only the conditions of production, but also of consumption and distribution. Indeed, public policy is the social embodiment of economic subject, Man himself. Therefore, leaving this out makes the whole theoratical framework an empty exercise.

This leads to the hypothese of this study:

1. Comparative advantage is not a factor which is vested and fixed;
2. The state of comparative advantage is constantly changed by the interaction of the public policy and the entrepreneurs' adaptability to their changing economic reality;
3. Comparative advantage is not a sufficient driving force of international trade, but a necessary factor resulting from exogenous efforts;
4. The active driving force of international trade and the determinant of international trade patterns are the wills of entrepreneurs and government to improve the income and employment levels through market expansion.

This broadens the scope of assumptions because public policy necessarily implies value judgements of society.

7. METHODOLOGY AND BACKGROUND

This study is basically exploratory. Accordingly, historical method was used to substantiate the hypotheses of the study. By examining the growth of the U.S. aerospace industry and its export pattern during the last seventy years, this study attempted to suggest a new way to explain the export behavior of an industry. Especially, for the purpose of appreciating the causation in international trade, an intuitive observation of economic phenomena is inevitably necessitated.

Past research has suggested that exports play a significant role in expanding national income via multiplier-accelerator effects. However, they offer no explanation as to what causes the present patterns of foreign trade, and by what mechanism. If we are to address ourselves to these questions, we must utilize empirical data. The U.S. aerospace industry is an ideal case to use in addressing this inquiry.

As of 1975, its total sales amounted to $28 billion and its total employment was 942,000. Of its total sales, public expenditures amounted to $14 billion representing about one half of the total sales of the industry.[42] Such spending may cause inflationary pressures. However, it is the price we pay for national security and therefore is a political problem.

Defense spending, nevertheless, does have some positive impacts on the expansion of national income via exports. As of 1975, exports totaled $7.8 billion. Commercial products accounted for most of the exports, totaling $5.3 billion and compounded of $2.4 billion in commercial transport deliveries and $2.9 billion in other civil products. The exports of military products totaled $2.5 billion. All together aerospace exports amounted to 7.4 per cent of all U.S. exports. However, because aerospace imports are minor, net trade balance of the industry is well over $7 billion. This constitutes 73.4 per cent of the U.S. trade surplus for the year.[43] Therefore, the aerospace industry industry was the single most important sector of the economy in lieu of the balance of payments.

But the U.S. aerospace industry was not in that unique position from the very beginning of its turbulent history. Despite the fact that the first successful flight was done by Americans, the U.S. aircraft industry itself was well behind the British until the 1950's. The reasons are: First, the technological level of related industries as well as aeronautics itself lagged behind that of the Britain. Second, military demand which was even more crucial than it is now was particularly soft because the U.S. was then under self-imposed neutrality. Third, all the social infra structures necessary for the industry development such as airports, regulation, and pilots were inadequate. Last, demand was cyclical and erratic so that it was difficult for the industry to maintain a steady team of researchers and developers as well as maintaining production level.

The outbreak of World War II and subsequent changes of public policy transform the whole industry drastically. Technological gap was narrowed and eventually surpassed owing to the unlimited public expenditures on research and development. Military demand was sky rocketed with not only domestic procurement but also foreign demand from all the Allies. Virtually every county comes to have large or small airport. An unlimited number of pilots, trained by military, came into civilian market and the most rigid safety regulation was put into force thus raising the public confidence in aviation. This shift of public policy was further enhenced by the intensification of the cold war and the space race between the U.S. and Soviet Russia.

As a result of this comparative advantage between the U.S. and British aerospace industries was totally reversed. So were the patterns of foreign trade regarding aerospace products which we would look into more thoroughly in the next chapter. In short, comparative advantage is not something which suddenly appears out of nowhere, but is the cumulative result of tenacious and deliberate public policies.

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CHAPTER III. GROWTH OF THE U.S. AEROSPACE INDUSTRY

1. DAWN OF AIRCRAFT INDUSTRY

It all began at Kitty Hawk on the 17th of December, 1903. The 12 second flight over the distance of 100 feet opened a new era of history. The beginning of the aircraft industry, however, was not glorious. The Wright brothers established the first aircraft company in 1909 but it was soon closed. The U.S. aircraft industry lagged behind its European counterpart. In 1914, when the Bureau of Census recognized the existence of the industry, there were only sixteen companies which produced 49 aircrafts during the year.[1]

Initially during World War I airplanes were used as scouts observing enemy forces. But it was soon recognized that the airplane was also useful as a combat weapon. In 1915, the Allies placed their first orders to the U.S. to ease their own domestic porduction. However, the U.S. aircraft industry was not ready for the task. A prime bottleneck was the tangled patent controversy in the U.S. aircraft industry. Consequently, it was difficult to get orders filled because some companies would not invest for fear that suits brought against them would force them out of business.[2]

To solve this problem the National Advisory Committee for Aeronautics(NACA) proposed to the industry that they draw up a patent licensing agreement whereby everybody making planes for the government might share the patents. The cross-license agreement similar to that under which the automobile industry had been working for years was to be administered by a new organization of the aircraft industry. That organization was the Manufacturers Aircraft Association(MAA). Any aircraft manufacturer could become a member and have the use of all patents under the agreement. The Association was to collect a blanket royalty fee of $200 for each plane and apportion it among the patent owners as stipulated.[3]

Yet many problems remained to be solved. There was no time to design and test a new aircraft, however, no operational fighter had been fully developed in the U.S. Only the European aircraft industry had accomplished anything in that direction. The British De Havillands was adapted by the U.S. as a production model. But the Allied Missions insisted that the U.S. produce only parts and engines while the planes were to be assembled in Europe. In spite of all of these difficulties, an ambitious program of producing 20,000 combat planes and 9,000 trainers was inaugurated. The number of employees increased rapidly from 5,000 to 175,000.[4] Other industries including, the automobile industry, were called upon in the production which had rapidly expanded.

Congress appropriated $1.6 billion for the Army Air

Corps during the twenty-one months of the U.S. participation in the war. But nearly half of that amount remained in the U.S. Treasury. After the war another large sum was recovered through liquidation and sales of supplies. A considerable amount was spent abroad since the U.S. aircraft industry was not ready to supply aircraft of the required specifications. The Army purchased 5,229 airplanes and 7,059 aircraft engines from European aircraft industry. With spare parts and the other supplies total foreign expenditures amounted to more than $139 million. About $350 million was spent on airplanes, engines, and spare parts in the U.S. Approximately two-thirds of this was for engines. For this, the Army received a total of 13,894 airplanes and 41,953 aircraft engines, including spare parts for both planes and motors.[5] U.S. aircraft production up to the Armistice is shown in the following table 5. Data are not available prior to 1911.

It was not until the Armistice was signed that the U.S. aircraft industry geared up to full production. However, the Armistice threw the industry into a chaos of reorganization. The military already had more airplanes than it could use.

The U.S. aircraft industry was left overcapitalized, over-manned, and over-stocked. Many firms quickly went out of business. Three months after the Armistice the aircraft industry was liquidated to ten per cent of its wartime strength.

Table 5. U.S. Aircraft Production
1912 to 1918
(Number of Aircraft)

Year	Total	Military	Civil
1912	45	16	29
1913	43	14	29
1914	49	15	34
1915	178	26	152
1916	411	142	269
1917	2,148	2,013	135
1918	14,020	13,991	29

Source: Aerospace Industries Association of America, Aerospace Facts and Figures, 1963, Washington, D.C., pp. 6-7.

The remaining firms relied on the small military procurement at irregular intervals.

The industry created the Aeronautical Chamber of Commerce in 1922 to promote commercial aviation. Until then the industry was caught in a vicious circle. It could not sell machines, therefore, it could not finance research and development. And until it could produce better aircraft, there was little chance of procuring the financial support necessary for commercial aviation. The Chamber appealed to the government for help. President Coolidge appointed an Aircraft Board under the chairmanship of Dwight Morrow.[6] This Board held hearings and rendered an exhaustive report. As a result of this the National Air Law was passed in 1926, placing the responsibility for control of commercial aviation in the Department of Commerce. A Five-year procurement programs were also adopted for the military, providing for an increasing number of aircraft each year until 1932.

Then came the Lindbergh's epic flight from New York to Paris in May 1927. Public enthusiasm exploded and aviation became popular overnight. This along with other flights such as a transcontinental non-stop flight, around-the-world flight, and a North Pole flights ensured a formidable position for the industry in public opinion. The U.S. aircraft industry had finally gained the recognition necessary to carry on the progressive development of aviation. From 1927 to 1929 industry sales were increased from 21 million dollars to 71 million dollars.[7] But subsequently industry sales dropped to 26 million dollars in 1932. Civil aircraft production dropped from 5,516 in 1929 to 803 in 1932. (See Table 6) This transition was reflected in the stock price of the Wright Company which produced the engine for Lindbergh's Spirit of St. Louis. "A month before the flight it was selling at 25, and by December, 1927, it had more than tripled in value, going to 94 3/4; in another year it reached 245."[8] Subsequently, however, it dropped to 10 3/4 in 1930.[9]

The prime customer of the industry has always been the U.S. government. During the five-year program from 1927 to 1934, it appropriated 436 million dollars. The military

Table 6. U.S. Aircraft Production
1919 to 1938
(Number of Aircraft)

Year	Total	Military	Civil
1919	780	682	98
1920	328	256	72
1921	437	389	48
1922	263	226	37
1923	743	687	56
1924	377	317	60
1925	789	447	342
1926	1,186	532	654
1927	1,995	621	1,374
1928	4,346	1,219	3,127
1929	6,193	677	5,516
1930	3,437	747	2,690
1931	2,800	812	1,988
1932	1,396	593	803
1933	1,324	466	858
1934	1,615	437	1,178
1935	1,710	459	1,251
1936	3,010	1,141	1,869
1937	3,773	949	2,824
1938	3,623	1,800	1,823

Source: Aerospace Industries Association of America, _Aerospace Facts and Figures_, Washington, D.C., 1963, p. 6.

demand was confined to ten companies which received roughly 90 per cent of this business. In other words, the other 286 companies manufacturing planes had almost no participation in this stable business.[10] Even among the ten largest manufacturers, United Aircraft and Transport and Curtiss-Wright dominated this government market. One of the reasons for this concentration was the complicated method of negotiatting government contracts so that practically all were let on a non-competitive basis. Their relative market share is shown in the table 7.

Table 7. U.S. Aircraft and Engine Sales; 1927 to 1933 Millions of Dollars (Percentage in Parenthesis)

Companies	Navy	Army	Commercial	Total
U A & T	33.2(28)	17.0(29)	28.1(48)	78.0(42)
Curtiss-Wright	15.7(23)	29.0(50)	26.8(46)	75.6(39)
Subtotal	48.9(71)	46.0(80)	54.9(94)	149.0(81)
Total of Independents	19.7(29)	11.9(20)	3.6(6)	35.1(19)
Total	68.6(100)	57.9(100)	58.5(100)	184.9(100)

Source: Compiled from Delaney Hearings, 73rd Congress, Washington, D.C., 1934, pp. 502-503.

Congress began to question the military procurement procedure in 1934. Congressman McFarlane stated that "Of the 4,245 engines purchased by the Army since the Aircraft Act of 1926, 2,492 were purchased from Pratt & Whitney, and 1,153 from Wright, 587 from Wright Subsidiaries, and only 13 from all other engine manufacturers together. Since the Aircraft Act of 1926 the Navy obtained 2,149 engines from Pratt & Whitney, 971 from Wright, 2 from Wright subsidiaries and 36 from all others."[11] He also asserted that the manufacturers monopolizing military procurements were subsidiaries of the same large groups that monopolized air-mail contracts; and that the large profits made by these subsidiaries were not directly subject to taxation, since the parent companies filed consolidated income-tax returns. He estimated that the government's loss due to this was over 2 million dollars from 1928 to 1932.[12]

In 1933, the Crane Committee reported that interlocking interests and directorates had prevented the development of aviation, and had resulted in the waste of public funds. This Report recommended that operating and manufacturing companies be separated.[13] After the great upheaval the industry was separated into two parts: transport and manufacturing. Then the Watres Act of 1934 was passed. The Act prohibited interlocking directorates, overlapping interests, certain consolidations or mergers, and mutual stockholdings in order to break the monopoly of the large groups. These provisions were reaffirmed in the Civil Aeronautics Act of 1938.[14]

But as the international political atmosphere grew tense the aircraft industry was again in the limelight. It had become the most crucial means of national security to be cultivated and nurtured. This drastic shift in its role is also a reflection of the change in the conception of modern warfare in the military sector. The change in sentiment from neutrality to defense-at-all-costs was a major factor in the expanding defense budget. Industry sales shot up from $44 million in 1934 to more than $600 million in 1939.[15]

Meanwhile, Congress was shocked at the participation of the aircraft industry in the international arms trade. Public policy of the U.S. was not to associate with the "foreign entanglements." Thus, in 1934, the Congress passed a Joint Resolution to prohibit the foreign sale of arms or munitions of war. Despite these policies, U.S. aircraft exports steadily flourished as the international situation deteriorated. Aircraft exports surged upward with the exception of a brief downturn in 1935 which was due to the Nye Committee hearings and the Neutrality Law. By 1938 they accounted for 46 per cent of the industry sales compared with 5.7 per cent ten years ago.[16] (See Table 8) Even when the U.S. total exports declined in 1938, aircraft exports increased 73 per cent over the last year. Much of this rise was due to the fact that the U.S. was the only major supplier left out of the war. Consequently, the withdrawl of large producing countries from the world market left it open to the U.S. manufacturers. By 1937, the U.S. accounted for over 45 per cent of the world's total aircraft exports. Exports sales of the rest of the world was $66 million compared to $68 million for the U.S. in 1938.[17] This gap was further widened as the European War started in the late 1939.

A new Joint Resolution on neutrality was enacted by Congress in 1939. This new resolution included provision for a "cash-and-carry" system. The lifting of the embargo and the new Act benefited aircraft industry the most.[18]

Table 8. Total Production and Exports of Aviation Industry
1925-1936
(Billions of Dollars)

Year	Total	% of Exports to Production	Exports
1925	12.8	6.1	0.8
1926	17.7	5.8	1.1
1927	30.9	6.2	1.9
1928	64.7	5.7	3.7
1929	91.1	10.0	9.1
1930	60.8	14.5	8.8
1931	48.5	10.0	4.9
1932	34.9	22.8	7.9
1933	33.4	27.5	9.2
1934	43.9	40.2	17.7
1935	42.5	33.7	14.3
1936	78.1	29.6	23.1
1937	115.1	34.2	39.4
1938	150.0	45.5	68.2
1939	225.0	52.0	117.1

Source: Aircraft Production: U.S. Bureau of Air Commerce, Progress of Civil Aeronautics in the United States: 1937 figures, Wall Street Journal, June 13, 1938, Aircraft Exports: Compiled from U.S. Bureau of Foreign and Domestic Commerce. Foreign Commerce and Navigation of the United States, 1939 and Aeronautical World News, 1939.

2. WORLD WAR II AND REORGANIZATION*

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* This study does not consider the role of the trade unions, especially of such leaders as Sidney Hillman, Co-Chairman of the War Production Board(WPB), or Walter Reuther of the Automobile Workers Union which then included aircraft workers, or of his brother Victor; or of the Government in which men like Isadore Lubin of the White House Staff, J. Douglas Brown, Robert R.R. Nathan and others of WPB. Unions and Government, of course, contributed mightly to the aircraft effort. The interested reader may consult a rich literature on the war effort cited at reference # 24.

As the U.S. entered the War the aircraft industry became an arsenal of democracy. By 1943, the U.S. aircraft industry had become the largest industry in the world and its product was one of the most crucial factors in winning the war.

On January of 1942, President Roosevelt requested that aircraft production be increased to 125,000 units in 1945. Actual production in that year was 85,946 units. But, in terms of weight and performance, it produced more than the equivalent because of the emphasis on the production of heavier and faster aircraft. The War Production Board (WPB) Statistics reveals a dramatic shift of aircraft specifications. The WPB calculated plane output for the period from 1941 to 1944 on the basis of the sizes, types and proportions produced 1942. The Board estimated that aircraft production in 1943 was equivalent 122,000 1942-type planes, and that the target of 100,000 units in 1944 would be equivalent of 167,000 1942-type planes. Thus, the presidential goal was actually exceeded. This rapid expansion was made possible by the huge U.S. war expenditure of about $200 billion, of which aircraft procurement, excluding armaments, was about twenty five per cent.[20]

The subject of greatest interest was production efficiency, which increased approximately twenty-fold during that period. For the average monthly weight output per employee, which was 28 pounds in 1941, was 125 pound in 1944.[21] Improvement of performance was more or less stabilized since there was no time to design, develop and produce completely new models.

The Aircraft War Production Council(AWPC) produced an interesting statistic on productivity. The AWPC cited the case history of a typical fighter plane from the first to the thousandth unit. Every doubling of the production meant an increase of 75 per cent in productivity. By the time a thousand units had been produced productivity increased by twentyfold. (See Table 9)

Table 9. Productivity Improvement in Each Production Level

Number of Units	Change of types	Man-hours
1st	A	157,000
10th	A	59,000
13th	B	59,000
90th	B	50,000
100th	C	26,500
700th	C	19,500
1000th	C-F	7,800

Source: R.M. Cleveland and F.P. Graham(eds.), The Aviation Annual of 1945, Garden City: Doubleday , Doran & Co., 1944, p. 78.

The production history of the four-engine bomber demonstrates the same point. The first aircraft required 200,000 man-hours for construction: the 1,000th plane took

22,500 and the 2,000th only 13,000. In this case productivity was increased sixteenfold. Another criterion of productivity is price. Production costs in 1944 was reduced by 20 to 40 per cent compared to the same plane built in 1942. Otherwise aircraft procurement would have cost more than $15 billion. For instance, in case of the B-24, the government ordered 1,200 B-24s at $238,000 each in 1942. But in 1944, 4,500 additional B-24 were contracted at $137,000 each. The saving involved was roughly $100,000 on every B-24, amounted to half a billion dollars.[22] This dramatic improvement in efficiency was due to the economies of scale as government procurement increased explosively. (See Table 10)

Table 10. U.S. Aircraft Production
1939 to 1945
(Number of Aircrafts)

Year	Total	Military	Civil
1939	5,856	2,195	3,661
1940	12,813	6,028	6,785
1041	26,289	19,445	6,844
1942	47,675	47,675	---
1943	85,433	85,433	---
1944	95,272	95,272	---
1945	48,912	46,865	2,047

Source: Aerospace Industries Association of America, *Aerospace Facts and Figures*, Washington, D.C., 1963, p.6.

The crash development program produced favorable results in a short time. For instance, Curtiss-Wright Propeller Division produced hollow steel blades for combat use. Hamilton Standard developed hydraulic pitch controls and other major propeller manufacturers also greatly increased research and development. The most prominent innovators were the Aeroproducts Division of General Motors and the American Propeller Corporation. In the instrument area, Sperry Gyroscope, RCA, Western Electric, and Bendix developed countless revolutionary devices such as automatic pilots, automatic gunsights, automatic bomb sights, and navigation systems.[23]

Above all, a revolutionary device developed during the war was the vast array of the subcontracting network. The factories best equipped to do a particular job did an increasing share of the whole industry's work along those lines, and accordingly increased the efficiency of production. Non-aviation subcontractors, who had reluctantly accepted small orders, began to expand as they were assured a high demand for a product which they had learned to make efficiently. They became, in effect, departments of prime contractors. Others shifted from making many items to making a single or several units thus more efficiently. At the same time prime contractors disposed of small departments as they expand further.

The net effect of this new system was profound: First, it put the aircraft industry on a mass-production basis. Second, it made prime contractors basically the designers and assemblers of aircrafts. Prior to the war they had turned raw materials into finished products. But now they are not aircraft builders or even engine, propeller, or instrument producers in the prewar sense. By 1944, about 60 per cent of the value of total production was added by subcontractors. The varied output of subcontractors were directed into a score of narrowing channels, each representing a different type of aircraft. At prime contractors' assembly lines, the multitude of airplanes parts built elsewhere were checked, put together, and tested. The result was an enormous increase in productivity.[24]

As the war was neared its end, the reorganization of the industry became a grave problem to all concerned. In 1938, the industry consisted of a total of 15 companies. By 1940, this number had increased to 41 and in 1943 to 86 factories including 5 plants in Canada. Total assets increased from $114 million in 1939 to $3.9 billion in 1944. Working force increased from a meager 48,638 in 1939 to 2.1 million by the end of 1943. Demobilization of this gigantic working force was just as difficult a task as the mobilization of it. On V-J Day about $9 billion of contracts were cancelled. The net effect of cutback was the cancellation of approximately 90 per cent of existing contracts. Accordingly 1.1 million workers were laid off.[25]

The effect of the unemployment caused by the aircraft contract cancellation was of national concern, but the effect upon the surplus problem was of particular interest to the industry. A total 100,000 aircrafts and 50,000 spare engines were expected to be declared surplus. About 30 per cent of the first 40,000 aircrafts declared surplus were sold or leases.[26] The industry expressed grave concern over this matter.

It argued that although disposing surplus is the economic course to follow in the short run it results in inefficiencies in the long run. For example, World War I Liberty engines were carried on the stock list until 1932. The effect of this policy resulted in a halt of research and development on liquid-cooled engines, because there was no market for them. Thus when the Second World War Broke out the U.S. was far behind Europe just as it was 21 years earlier at the time of World War I. So was the case of the Liberty-engined reconnaissance aircraft operating until 1935. Thus the aircraft industry argued that the policy of "holding on" to the surplus aircraft constituted a grave menace to the technological progress of the industry.[27]

It further contended that small research and experimental contracts were not the solution to the pressing need for keeping ahead in the world of aviation, because of the time lag in development and production. In another war there would be no time to convert to wartime production as had happened in the last two wars. Therefore the production line is as essential as combat aircrafts in action. As time lag becomes longer, as aircrafts become more and more sophisticated and heavier, the thrust of this argument becomes stronger.

The same argument holds for government owned facilities and equipments. Of the total of $3.7 billion expanded during the war, $3.4 billion were federally financed. Prewar privately finance facilities were valued at $114 million. Thus the government owned 90 per cent of the total facilities.[28] Most postwar commercial transports, however, were modified wartime models with identical basic structure. Since complete assembly lines for the production of these were owned by the government, the industry could not produce commercial airliners until these facilities were disposed of. These industry proposals were adopted by the government and thus became the cornerstone of the U.S. aircraft industry.

By the end of 1945, the government had cancelled contracts totaling $21.6 billion. Industry sales declined from a peak of $16 billion in 1944 to $1.2 billion in 1947 and only 16 out of the 66 aircraft companies remained in business. The most significant effect of this cancellation was on the rapid reduction in the employment level. The peak of 2.1 million was reduced to 1.5 million by V-E Day (May 8, 1945) and to 519,000 by V-J Day(August 14, 1945). A steady reduction continued until a bottom of 138,700 was reached in 1946.[29] The reduction of employment began even before the war ended. The expansion of production facilities ceased by the end of 1943 and airframe engine production after June, 1944; and propeller production after January, 1944.[30]

Accordingly the aircraft industry prepared for the conversion to a peace time economy. Although civil aircraft production rose to about 35,000 planes in 1946, nearly five times that of the war year, military sales were still the bulk of the industry sales. It was important to achieve a balanced production policy in the military sector. Procedures for orderly contract termination were adopted in 1943 and were incorporated into the Contract Settlement Act of 1944.[31]

In order to avoid needless disruption on the industry when military requirements disappeared, the contract termination process attempted to:

1. Phase out the war contract as gradually as conditions permitted,

2. Prevent manufacturers and their subcontractors from being left with vast quantities of unusable inventory, and
3. Provide some assistance in reconverting to peace time production. The normal pattern was for the subcontractors to cut back first, so that the industry gradually resumed its prewar structure.[32]

By 1950 the employment of the aircraft industry recovered to 224,900.[33] This representing one-sixth of that of 1944 and three times that of 1940.[34] And the industry produced 6,200 units with a total value of $1.4 billion representing one tenth of that of 1944. In this process many new companies disappeared but the old companies that constituted the prewar industry remained. Out of the fifteen major companies only two companies, McDonnell Aircraft corporation and Northrop Aircraft Incorporated were established during the war.[35] And of the major companies in 1940, only three Vega, Vultee, and Brewster failed to appear on the 1950 list. This shows a striking stability of market share considering the erratic nature of demand.

In the jet engine field, however, prewar patterns of the industry have been greatly disturbed. Nonaircraft companies, General Electric and Westinghouse, were granted government funds for research and development of jet-engines during the war while the established engine makers were required to concentrate on reciprocating engines. Consequently the former took an early lead in jet engine production.

The crippled aircraft industry after World War II recovered instantly as the Korean War broke out in June, 1950. Military aircraft production increased from 2,600 units in 1949 to 9,000 units in 1953 and the floorspace utilized was doubled.[36] This drastic change is shown in the following table 11.

Table 11. U.S. Aircraft Production 1946-1956 (Number of Aircrafts)

Year	Total	Military	Civil
1946	36,418	1,147	35,001
1947	17,739	2,122	15,617
1948	9,838	2,536	7,302
1949	6,137	2,592	3,545
1950	6,200	2,680	3,520
1951	7,532	5,055	2,477
1952	10,640	7,131	3,509
1953	13,112	8,978	4,134
1954	11,478	8,089	3,389
1955	11,484	6,664	4,820
1956	12,408	5,203	7,205

Source: Aerospace Industries Association of America, <u>Aerospace Facts and Figures</u>, Washington, D.C., 1963, p. 7.

Much of production increase was achieved by utilizing branch plants and by subcontracting work. The reason was that the government was reluctant to finance new investment when it already possessed much idle floor space and equipment.[37] Aircraft manufacturers, on the other hand, found wartime facilities poorly suited for larger jet aircraft production. Thus, the decrease in government finance resulted in a larger private investment. This was also facilitated by the Defense Production Act of 1950, which allowed producers to amortize new investment over a five-year period for tax purposes.[38] One of the reasons for such obsolescence was the increase in size and weight of the airplanes.

Also the need for additional land space around plants became acute as the jet engine was introduced. Runways designed for propeller driven aircraft were no longer suitable. Extending the old runways was often impractical because of a noise problem and the development which had already taken place around them. All in all, these events necessitated a large amount of private capital investment. The following table shows clearly that the private sector spent more during this period than it did during World War II period.

There were three reasons why the industry invested its own money rather than wait for the government to invest. First, the government refused to finance expansion so long as usable facilities existed. Second, there was a huge demand for new machine tools requiring further development. The government preferred to employ its facility contracts

Table 12. Cost of Emergency Facilities Expansion (Millions of Dollars)

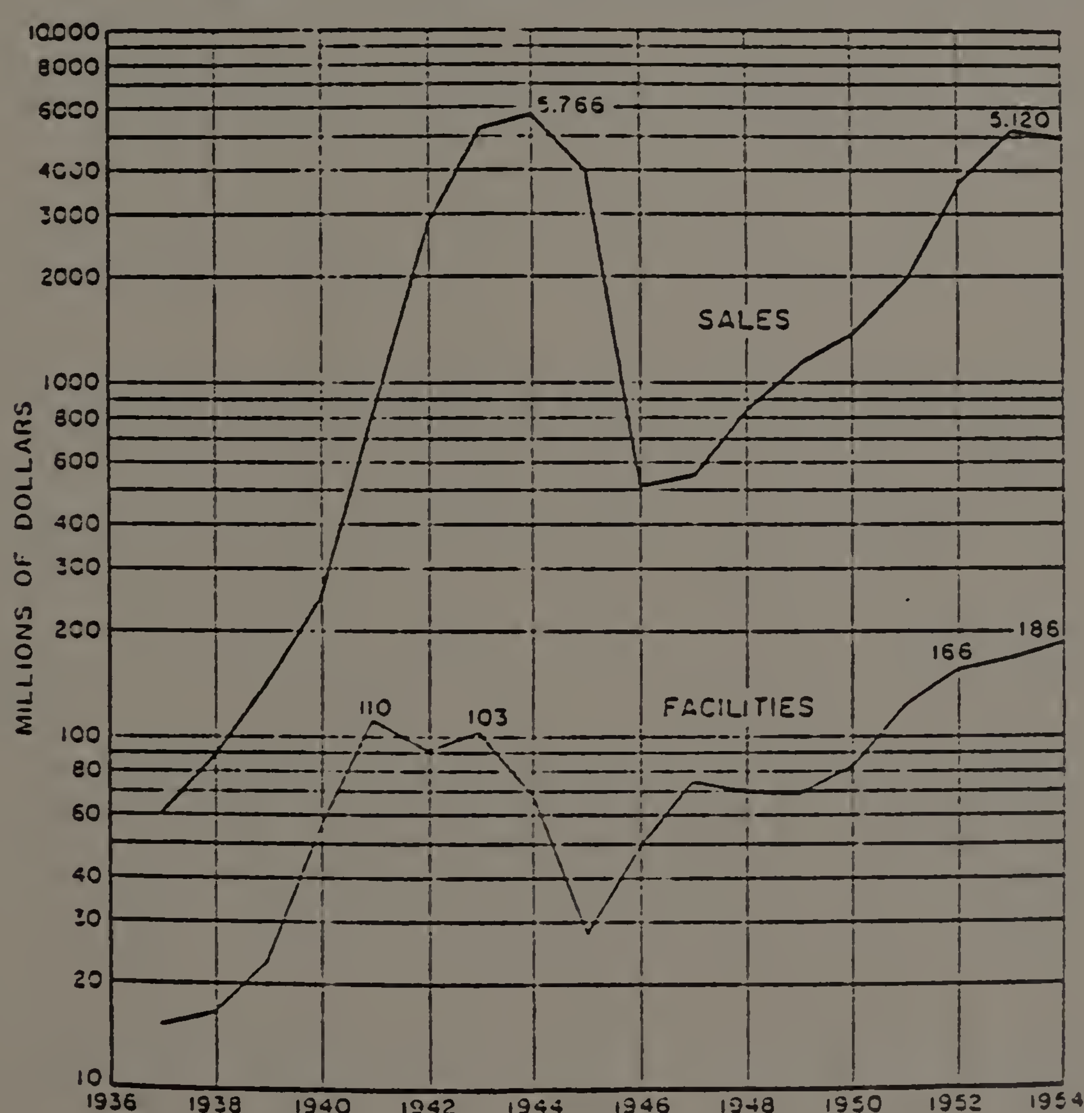
Types of Investment	Types of Finance	1940-1945	1950-1953
Structures	Private	212	805
	Federal	1,344	280
Equipment	Private	208	399
	Federal	2,130	2,044

Source: R. Modley and T.S. Cawley, Aviation Facts and Figures, 1953, Washington, Lincoln Press, Inc., 1953, p. 11.

to further machine tool development and to pay for the installation of some of this equipment. As a result of this policy the government financed much of the new equipment, making the industry concentrate upon expanding other facilities. Third, the government offered accelerated depreciation during the Korean War as it did during World War II. This became the most powerful incentive for a firm to plow back its earning, although the straight five-year period was not quite as attractive as the World War II period of five years or the duration of the war which ever was shorter.[39]

Accordingly, unless the government finances fixed assets, the industry must maintain them to meet the unpredictable cyclical swings in production. Such a capital structure would be a costly burden to both the private and public sectors in the long run. Therefore, the industry has been extremely cautious about expanding facilities beyond the point which they can be profitably employed during the low swings of the aircraft procurement cycle. For instance, during both wars, sales increased at a much faster rate than did fixed assets as shown in the following Graph 1. This is mainly due to the government policy on aircraft procurement.

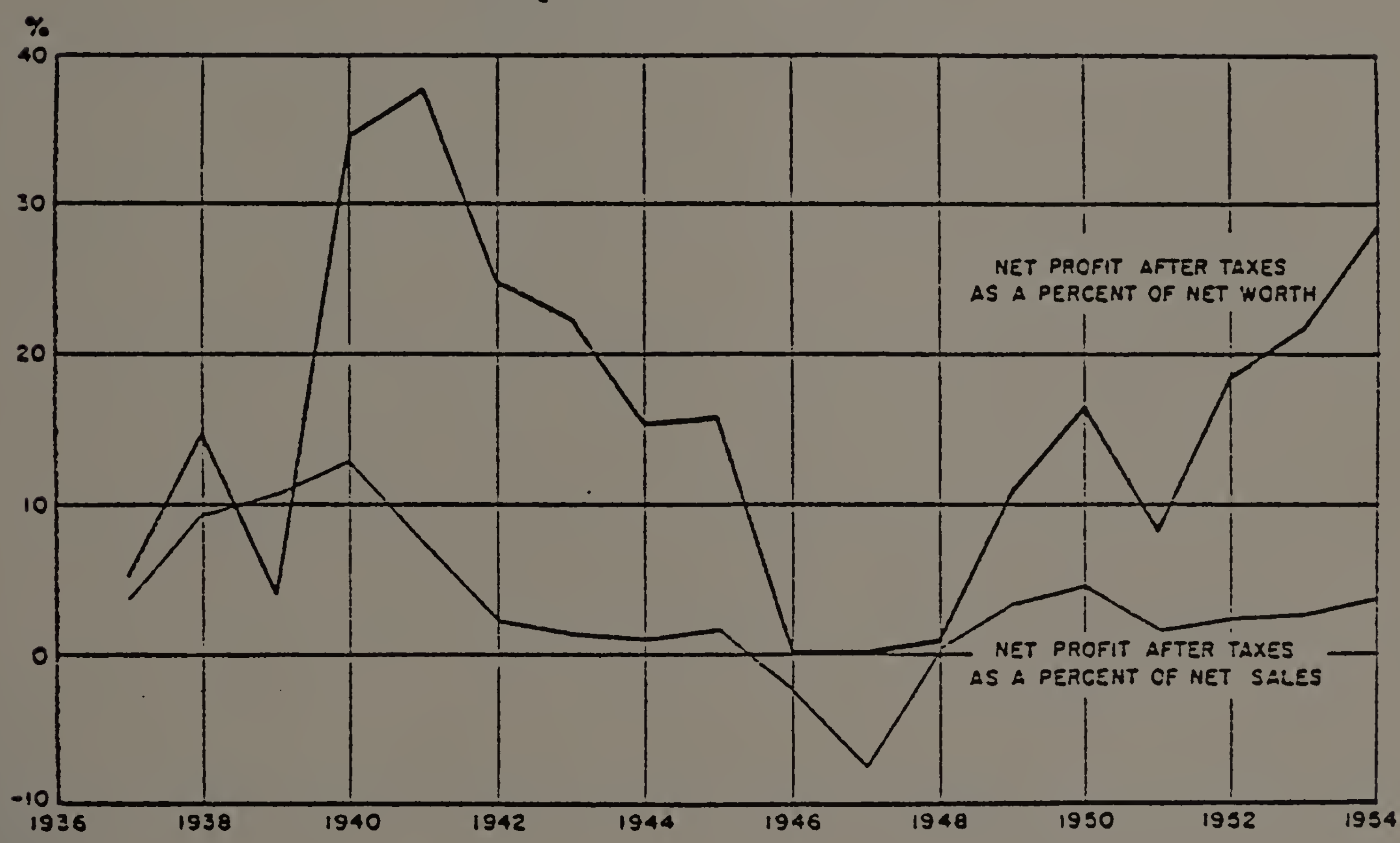
Graph 1. Net Book Value of Facilities and Sales of 12 Major Airframe Companies, 1937-1954



Source: Aerospace Industries Association of America, _Aviation Facts and Figures_, Washington, D.C., 1955, p. 83.

There was the belief held throughout the industry that earnings were much too low to justify risky investment. Graph 2 shows earnings as a percentage of sales for 12 major aircraft companies during the periods. Earnings as a percentage of networth climbed much faster because of the wide employment of government-owned facilities.

Graph 2. Financial Ratios of 12 Major Aircraft Companies, 1937-1954



Source: Aerospace Industries Association of America, _Aviation Facts and Figures_, Washington, D.C., 1955, p. 84.

Government financing, however, provided government officials with an extremely potent control over the industry. Control factor was as a means of forcing the prime contractors to accept subcontracting in lieu of new plant construction.[40]

Government financing was predominant throughout the industry. The reasons are following: First, the aircraft industry, which had paid out 50 per cent of its earnings in dividends, was in no position to tie up funds in non-productive plants and equipment.[41] This dividend payout ratio is minimum since, the profit margin of the industry is substantially lower than that of other manufacturing industries. Second, even if the government allowed profit margins to increase, the rapid expansion during a war would still require a huge public expenditure.

However, there were few licensing arrangements as during World War II. Indeed the only two instances of major licensing were the formation of the B-47 pool with Boeing as the "design prime" and Lockheed and Douglas as the other prime contractors; and the Republic Aviation-General Motors agreement.[42] There were two reasons for this absence of licensing. First, the over-all production never reached the World War II level. The peak production in 1953 was about 150 million pounds compared with 962 million pounds in 1944.[43] Second, the 1939 expansion commenced with 9.5 million square feet of floor space being used whereas the Korean requirement were supported by an initial operating plant of over 60 million square feet plus a considerable number of government-owned reserve plants.[44] Therefore, subcontracting, with its greater flexibility, had more appeal than the licensing arrangement for both concerned parties.

3. BIRTH OF AEROSPACE ERA

Following the Korean War, the aircraft industry has experienced fundamental changes, namely the emergence of guided missiles and rapid expansion of space procurement. On October 4, 1957, the Soviet Russia sent the first man-made object into orbit. Russian success shocked the American public. Soon the National Aeronautics and Space Administration(NASA) came into being in the fall of 1958. Drawing initially from the defunct National Advisory Committee for Aeronautics(NACA), the Navy Vanguard team, and the Army Jet Propulsion Laboratory, NASA grew into a large well organized unit by mid-1962 with a clearly defined goal of landing men on the moon, and returning them safely before the Russians did.[45]

Because of their superior speed in the delivery of destructive power, missiles are considered a superior substitute for aircraft. Accordingly, the military aircraft market contracted abruptly while the missile market was expanding sharply. If the aircraft industry was to survive, it became obvious that either it diversify into other areas and expand its civil aircraft market or it had to adapt their production to missiles, the latter being the more feasible alternative. The industry responded to the new challenge quickly. In 1959, the U.S. Aircraft Industries Association, Inc. changed its name to Aerospace Industries

Association of America, Inc., to reflect the changing nature of the effort. However, the transition to aerospace industry was not without its difficulties.

The facilities for aircraft production were no longer economical for missile production. For instance, high-ceiling areas meant wasted space if they were to convert to missile production. This meant more adventurous capital investment in the private sector in order to survive in the new born industry. In addition, missile production caused a great deal of change in the nature of labor force. Old jobs were destroyed and new ones were created as high technology was achieved. Between 1954 and 1962 the percentage of hourly production workers dropped from 71.6 per cent to 40 per cent of total employment as the proportion of more complex products increased.[46]

The aircraft industry, however, was able to adapt to the challenge imposed by the advent of the missiles. The following table 13 shows the new pattern of development. The six largest military contractors were also the largest contractors of missiles. Accordingly, high military sales levels depended upon capturing large missile contracts as the proportion of missile contracts in the defense procurement rapidly increased. For instance, Boeing became the second largest military contractor largely due to its successful missiles program while Douglas fell from number one

Table 13. Composition of Missile Sales in Military Sales of Nine Major Prime Contractors in Percentage

Company	Year	Missile Sales/ Military Sales	Missile Market Share
Boeing	1956	--	--
	1961	36.8	11.1
Chance-Vought	1956	37.3	3.5
	1961	3.9	0.1
Convair	1956	20.6	9.1
	1961	46.1	15.5
Douglas	1956	1.4	1.0
	1961	39.3	3.9
Lockheed	1956	--	--
	1961	69.4	17.3
Martin	1956	9.7	2.3
	1961	87.5	13.6
McDonnell	1956	2.8	0.4
	1961	18.9	1.4
North-American	1956	0.01	--
	1961	40.3	10.8
Northrop	1956	33.7	7.3
	1961	35.5	1.2

Source: Office of the Secretary of Defense, Statistical Abstracts of the United States, Washington, D.C., 1959, 1960, 1961.

to six because of not being able to do so. (See Table 13)

Accordingly, the structure of the aerospace industry has undergone substantial changes. Although the industry is principally made up of the same old companies, many new concerns entered into aerospace activities. Electronic manufacturers became a much more important part of the aerospace industry in some instances even becoming the prime contractors for new weapon systems. On the other hand, some aircraft companies such as Chance-Vought and Douglas which did not have the foresight to prepare for the transition into aerospace ended up as subcontractors to the more successful ones. In some instances companies were faced either merger or bankruptcy because of their inability to adapt to the new pattern of government procurement policy.

Until the middle of 1950's aircraft companies were usually supplied with government furnished equipment(GFE) e.g. engines, propellers, and bombsights. The companies would then assemble the complete aircraft and deliver it to the military service. They virtually had no further relationship with the delivered aircraft, unless it was returned for improvements or modifications. In the missile program, however, aerospace companies were given full management responsibility in most cases. Not only did the companies assemble the finished missiles but they also designed the ground-support equipment to make it usable. They managed deliveries of components and arranged production schedules under military supervision. They participated in selecting launching sites and were even involved in the actual site construction. And when the missiles became operational, field-service representatives of the airframe, engine and guidance-systems producers accompanied military personnel as trouble shooter.[47]

Consequently, customer-producer familiarity, as well as highly technically qualified personnel and related production experience became keys to retaining the ever increasing volume of missile procurements. The aircraft companies had an excellent foundation to start with. The aircraft companies, however, were in more competitive environment than they had ever been before, Until then, previous experience in aircraft production was a prerequisite for an invitation to compete for such a government contract. On the government side, this procedure assures predictable performance of producer. Hence, the market was closed to newcomers because experience could not be gained without production, but production requires experience. The introduction of the missile, however, changed the whole picture since experience no longer provided such an insurmountable barrier to new competition. In some cases, electronic producers were found to be better qualified technologically than aircraft producers. By 1956, non-aircraft producers were prime contractors on 10 of 26 missile projects.

This advent of the missile also rapidly devastated capital bases of the aircraft industry. Old facilities for aircraft production became technologically obsolete for missile production. Once again an extensive inflow of capital was needed from the private sector. From 1956 to 1961 the industry spent about $2 billion on facilities for the development and production of missiles.[48]

In case of missile production, the degree of concentration is even higher than that of aircraft production. In fact, the top five companies- Lockheed, Convair, Martin, Boeing, and North American- accounted for 91.5 per cent of missiles produced by aircraft companies and 68.3 per cent of the entire missile procurement.[49] Missile sales by the aircraft industry steadily increased. Meanwhile, the structure of industry sales had changed too. Missile sales accounted for 44.4 per cent of the total industry sales in 1961 compared with 5.7 per cent in 1956. Also the ratio of aircraft industry missile sales to total missile sales increased from 23.5 per cent in 1956 to 74.7 per cent in 1961.[50]

The aircraft industry's success in missiles can be attributed to its experience in responding to public policy and its established position in handling government business. By the time the aircraft industry was well transformed into the aerospace industry in the early 1960's, the top six military aircraft producers were also well entrenched as major missile producers. Thus the most significant feature of the U.S. aerospace industry in this period was probably this "resilient response" to rapidly changing public policy.[51]

Table 14. U.S. Aerospace Industry Sales by Customer
1957 to 1976
(Billions of Dollars)

Year	Total Sales	Aerospace Products and Services			Non-Aerospace Products and Services
		U.S. Government		Other Customers	
		DOD	NASA and Others		
1957	15.9	12.8	-	1.6	1.4
1958	16.1	13.2	-	1.4	1.4
1959	16.6	13.2	0.1	1.8	1.5
1960	17.3	13.2	0.4	2.2	1.6
1961	18.0	13.9	0.6	1.9	1.6
1962	19.2	14.3	1.3	1.8	1.7
1963	20.1	14.2	2.6	1.5	1.8
1964	20.6	13.2	3.6	2.0	1.7
1965	20.7	11.4	4.5	2.8	2.0
1966	24.6	13.3	5.0	3.7	2.6
1967	27.3	15.9	4.2	4.6	2.6
1968	29.0	16.6	3.9	5.9	2.5
1969	26.1	15.8	3.3	4.3	2.7
1970	24.9	14.6	3.0	4.6	2.6
1971	22.2	12.6	2.7	4.3	2.5
1972	22.8	13.3	2.6	4.3	2.6
1973	24.8	12.9	2.4	6.2	3.3
1974	26.4	12.7	2.5	7.2	4.1
1975	28.4	13.1	2.7	7.7	4.8
1976	29.3	13.4	2.8	7.8	5.3

Source: Aerospace Industries Association of America, <u>Aerospace Facts and Figures 1977/1978</u>, Washington, D.C., 1977, p. 9.

This resilience and creative response of the aerospace industry, however, was to be tested again in the early 1970's. After the Vietnam war military procurement was reduced to $12.6 billion in 1971 from $16.6 billion in 1968.[52] Also NASA contracts were reduced to $2.4 billion

Table 15. U.S. Aerospace Sales and the National Economy 1960 to 1976 (Billions of Dollars)

Year	Total Gross National Product	Sales: Manufacturing Industries	Sales: Durable Goods Industry	Sales: Aerospace Goods Industry
1960	506	346	174	17
1961	523	353	175	18
1962	564	390	196	19
1963	595	413	209	20
1964	636	443	226	21
1965	688	492	257	21
1966	753	554	292	25
1967	796	575	301	27
1968	869	632	336	29
1969	936	695	367	26
1970	982	709	363	25
1971	1,063	751	383	22
1972	1,171	850	436	23
1973	1,306	1,017	527	25
1974	1,414	1,061	529	26
1975	1,516	1,047	527	28
1976	1,692	1,183	605	29

Source: Gross National Product, Manufacturing, and Durable Goods Industries: Department of Commerce, Survey of Current Business; Aerospace Industries Association, Aerospace Facts and Figures 1977/1978, Washington, D.C., 1977, p. 12.

in 1973 from 5 billion dollars in 1966 as the Apollo project phased out.[53] (See Table 14) To make matters worse, domestic demand for commercial transport became soft as airline profits deteriorated. Increased fuel costs and wages coupled with the higher price tag of wide-body jets can only hurt already depressed market. As a result of this, the proportion of the aerospace industry in the gross national products steadily decreased. (See Table 15)

Table 16. U.S. Exports and Exports of Aerospace Products 1960 to 1976 (Billions of Dollars)

Year	Total Exports of U.S. Merchandise	Exports of Aerospace Products			
		Total	Civil Transport	Civil Others	Military
1960	20.4	1.7	0.5	0.6	0.6
1961	20.8	1.7	0.3	0.6	0.8
1962	20.4	1.9	0.3	0.7	1.0
1963	23.1	1.6	0.2	0.5	0.9
1964	26.2	1.6	0.2	0.6	0.8
1965	27.1	1.6	0.4	0.5	0.8
1966	29.9	1.7	0.4	0.6	0.6
1967	31.1	2.2	0.6	0.8	0.9
1968	34.2	3.0	1.2	1.1	0.7
1969	37.5	3.1	0.9	1.1	1.1
1970	42.6	3.4	1.3	1.2	0.9
1971	43.5	4.2	1.6	1.5	1.1
1972	49.0	3.8	1.1	1.8	0.8
1973	70.2	5.1	1.7	2.1	1.4
1974	97.2	7.1	2.7	2.6	1.8
1975	106.1	7.8	2.4	2.9	2.5
1976	113.3	7.9	2.5	3.2	2.2

Sources: Bureau of the Census, "U.S. Exports, Schedule B, Commodity and Country," Report FT 410, "Highlights of U.S. Export and Import Trade," Report FT 990.

Thus, the only alternative left to the aerospace industry was to extend foreign markets. Fortunately, concentration of wealth due to the oil crisis turned out to be a favorable factor for this case. The exports of aerospace products increased to $7.9 billion in 1976 from $1.7 billion in only ten years. (See Table 16)

But this time both defense and state departments officials became anxious for various reasons. First, the consequence of exporting military aircraft was not as simple as that of exporting lollypops. This may tilt the balance of power in any particular region. A friend of today may become an enemy of tomorrow and vice versa.

Second, as the proportion of exports increases, the management of the aerospace industry tends to become less dependent on the government procurement. This may not be in accord with government policy. Consequently, the government began to interfere in the exporting procedure, in full scale.

However, the U.S. aerospace industry is not in the same dominant position in the world market as it once was. The U.S. marketshare of the world market is reduced from 86 per cent in 1960 to 68 per cent in 1975 and is projected to 60 per cent by 1985.[54] European and Japanese aerospace industries as well as of Soviet Russia are increasingly competitive in both quality and price. The vacuum left by the U.S. aerospace suppliers was swiftly filled by the firm in the above countries. In the long run, therefore, restrictive export policy on aerospace products may only weaken the dominant position of the U.S. aerospace industry in the world market.

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19. John B. Rae, op. cit., p. 142.

20. R.M. Cleveland and F.P. Graham(eds.), <u>The Aviation Annual of 1945</u>, Garden City: Doubleday, Doran & Co., 1945, p. 77.

21. Ibid., p. 78.

22. Ibid., p. 81

23. E.E. Wilson, <u>From Kitty Hawk to Sputnik</u>, Ann Arbor, 1958, pp. 295-298.

24. The contribution of government and labor including trade unions, to the war production effort were enormous. Such efforts and their successes and failures, however, are beyond the scope of this paper which is directly concerned with the industry qua industry. The interested reader, however, has a rich literature at his disposal. Among the works which contribute to a knowledge of labor and government's contribution are following:
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CHAPTER IV. THE IMPACT OF PUBLIC POLICY ON THE EXPORTS OF THE AEROSPACE INDUSTRY

1. INTRODUCTION

If the story of the U.S. aerospace industry is a success story, then that of its British counterpart is a sad one. However, it is our proposition that public policy of both governments played an equally dominant role in determining the destiny of the industry in each country.

As recent as the 1950's, the British aircraft industry was well ahead of its U.S. counterpart. This is exemplified by the British Comet, the first commercial jet transport which went into airline service in 1952. This was a full six years ahead of a similar American aircraft, the Boeing 707.

Such a lead is vital in securing a marketshare for once an airline establishes an association with a particular aircraft manufacturer, it rarely breaks away. An airline's loyalty is based on economic reasoning to protect its investment. In the piston-engine era it was easier than at the present for an airline to change its fleet. However, with the coming of the jet airliner, airlines found it virtually impossible to switch from one manufacturer to another since stocking huge inventories and training maintenance staffs for a new airliner are prohibitively high. The British aircraft industry, however, failed to capitalize on its vital lead due to the indecisiveness of the government about the fatal crashes of the Comet.

By the time the Comet reentered the world market, all the major airlines were already committed to either Boeing or Douglas.[1] So the British tried to recoup the market with the VC-10 which has a wider body and a longer range than the Boeing 707 or DC-8. At that time the British government made it clear that it would not import any more jet transports for its own airlines. But this was suddenly changed when BOAC cancelled its order on the basis of the higher operating cost of the VC-10, which had completed its maiden flight. It later became apparent that this decision was based upon insufficient information since passengers preferred the roomier and more comfortable VC-10. Since that time the British aircraft industry has never regained its technological superiority to the U.S. aerospace industry.[2]

One of the main reasons for the failure of British aircraft industry was the feud between the Ministry of the Civil Aviation and the Ministry of Supply. Their constant frictions created too many stop-go decisions which resulted in too many prototypes and too few production models. In particular, the inefficiency of the Ministry of Supply which bought the airliners and sold them to the airlines was the prime weakness.[3]

Another reason for the success of the U.S. and failure of the British was the fact that the U.S. aerospace industry had exclusive access to the huge U.S. domestic market. The British industry did not have this advantage. About half of the world's air transport operations were in the U.S.[4] and penetration into this market by non U.S. firms has been almost impossible. This barrier existed even before the U.S. aerospace industry had attained any technological lead over its British counterparts. The relationship between industry and government in the U.S. and the resulting public policy played a crucial role in building this barrier.

As discussed in the preceeding chapter, many types of restrictions other than tariffs can be imposed upon the aerospace imports. For instance, when Eastern Airlines announced that it was going to lease four A-300s for the purpose of evaluation in 1977, the International Trade Commission immediately investigated the terms of the lease.[5] Many Europeans were convinced that the loss of the Western Airlines order for Airbus Industrie A-300, and refusal of the New York landing rights for the Anglo-French Concorde supersonic transport are based on less obvious government and industry pressures.[6]

On the other hand, the British aerospace industry is characterized by a series of constant stop-goes, stemming from its abrasive and displeasing relationship with successive Cabinets. This may be caused by the manner in which the British system of government works. The British system of government has ministers drawn from the Members of Parliament, who are professional politicians, while the senior civil servants are traditionally drawn from the Civil Service. These along with the abrasive relationship between government and industry, make it extremely difficult to form sophisticated decisions such as an advanced fighter bomber project. One of the consequences of this situation is the thrash-about in the early stages of any new government.[7]

In the U.S., the Executive Branch is basically run by professional administrators who are less political in decision-making than professional politicians. Also the U.S. can finance more projects simultaneously and afford more mistakes which are inevitable in any frontier technology. The jobs resulting from aerospace projects are significant factors in decision making process when the public sector can afford the burden. Accordingly, the labor unions have always been fervent supporters of the aerospace industry. However, if the public sector cannot afford the cost, as in Britain, it becomes a totally different situation. The different relationships between the government and the industry of the U.S. and that of Britain presents an opportunity to test the validity of the dynamic externality theory discussed in Chapter 3.

2. PUBLIC POLICY; A KEY EXTERNAL DETERMINANT

At the end of World War II, the British aircraft industry was in an ideal position to dominate the world market. In 1944, the industry was employing 1.8 million workers. Over 166,000 Rolls-Royce Merlin engines were built which amounted to more than any other engine built in aviation history.[8] The first aircraft with a jet engine flew in 1941 and the first production model of a jet-powered aircraft, Meteor, flew in 1944. The U.S. had to buy 400 Canberras when the U.S. industry could not produce what the Department of Defense wanted.

Furthermore, British commercial aircrafts were being manufactured on a substantial scale. The Viking in particular, achieved much success in the European market while the sales of the Dove totaled 550, of which one sixth had been sold to the U.S. The sales of the four-engined Heron exceeded 150. This is an indication of the technological lead of the British aircraft industry at that time.[10]

However, after the fatal crashes of the Comet in 1954, the British aircraft industry lost its lead in technology to the U.S. The reasons were clear: First, because of the friction among governmental agencies there were many projects which rarely went beyond the prototype stage. Also an inconsistent public policies taken by a frequently changing Cabinets contributed to the disarray. Frightened by the alarming level of deficit in budget and the balance of payments, any incoming Cabinet would be tempted to delete appropriations for aerospace research and development which was large enough to affect the fiscal position.[11]

Second, the expenditures on aerospace research and development actually decreased: the first available data for this purpose was 138 million pounds in 1961, and 159 million pounds in 1971.[12] Considering the devaluations of the pound during that period and the inflation, real funds available for research and development actually steadily decreased.

Third, the two research institutions established to advise the aircraft industry were mainly concerned with pure research, and not the practical problems of production. Originally the Aerodynamics Department of the National Physical Laboratory dealt with the theoretical issues while the Royal Aircraft Factory actually built the aircraft and the engines until World War I. The industry, however, grew jealous of the factory's position and exerted sufficient pressure to halt the factory work. The institution was then renamed, the Royal Aircraft Establishment(RAE). The RAE was to provide aerodynamic information on current aircraft problems and research on advanced aircraft design. The RAE, however, was not permitted to produce the aircraft itself. This placed the RAE in an unfortunate position for it had to advise the industry without being fully aware of some of the major problems faced by the manufacturers.[13]

Fourth, the British domestic market for aerospace products was limited compared to that of the U.S. Other countries with this problem were forced to purchase U.S. aircraft which gave them a great advantage of a well-spread out overhead development cost. The size of the domestic market, however, is not an unsurmountable barrier, although it poses a serious obstacle. For instance, Swiss watch makers with a small domestic market have long taken over the world market. But in order to overcome this, a country with a small domestic market such as Britain should have limited the scope of the industry and concentrated on a specific portion of the market. This might have increased their technical edge over the competitors.

Finally, the entangled government relationship is no less important than any of the other problems. The Ministry of Aviation was responsible for civil aerospace and the procurement of military aircraft prior to 1967. These functions were assumed by the Ministry of Technology and the Ministry of Defense. In 1970, the Ministry of Technology and Board of Trade became part of the Department of Trade and industry. Although that Department continued the Board of Trade's responsibility for civil aviation, the Ministry of Technology's responsibility for aerospace research, development and procurement and sponsorship of the aerospace industry was transferred to a separate and temporary Ministry of Aviation Supply.

In 1971, the Ministry of Aviation Supply was replaced by the Ministry of State for Defense. A Ministrial Aerospace Board is to be set up consisting of the Secretaries of State for Defense and Trade and Industry, to oversee collaboration between the two departments and became the authority for instructions and policy guidance on the industry.[14] This makeshift public policy and scattered responsibility impeded the development of the aerospace industry in which patient support and understanding is necessary. Whenever, a new institution took over the responsibility of overseeing the industry, it was more concerned with the imputation of what went wrong rather than how to solve the problem under these circumstances. Nobody wanted to take the risk of promoting a daring new project. In the long run, this probably hurt the British aerospace industry more than anything else.[15]

The British government which was desperate to rejuvenate its troubled aerospace industry, combined more than a dozen firms into two major airframe manufacturers and one engine manufacturer in 1974.[16] British Aircraft Corporation and

Hawker-Siddeley are concerned with airframe manufacturing and Rolls Royce with engine manufacturing. Finally two airframe manufacturers were merged into the British Aerospace Corporation in 1977.[17]

All of this demonstrates the crucial role of public policy in the development of the aerospace industry. As we saw above, these five critical factors are directly and indirectly affected by public policy. In most cases of model building public policy tends to be left out as an external factor since there is no way to quantify public policy. For instance, how could one quantify the impact of Sandy's Defense White Paper, which indicated that the manned fighter was dead and that in the future reliance would be placed on missiles? Yet the impact of this paper on the British aerospace industry, which was disregarded by the British government later, can hardly be exaggerated.[18] However, any model which leaves out such an important external factor as government policy is likely to be unrealistic. If public policy is included, its effects are difficult to quantify directly. Thus an appropriate way to consider public policy is to employ a historical method of analysis where relevant. This is probably the most we need to consider in the decision making process, since decision making is basically dichotomical no matter how sophisticated it may look.

3. RESEARCH AND DEVELOPMENT POLICY

Defense and space policies dictate the bulk of research and development activities in the U.S. due to the fact that the technological advancement of weapon systems is crucial to national security. Unintentionally, however, these public policies affect the whole economy in various ways. Its impact on the U.S. aerospace export is substantial, although this is not limited to the aerospace industry.

Keesing has stated that there is a powerful correlation between the intensity of R&D activity in American industries and their export performance.[19] Also a Brookings study indicated that technology is the key determinant of the rate of production and general economic progress.[20] That does not mean that other factors such as inflation, wage differences, and foreign exchange rate do not affect the export position. But, as far as aerospace exports are concerned, technological advancement is the single most important factor and the public policy on R&D directs it.

The U.S. aerospace industry receives about one half of all of the federal expenditure on R&D. This industry also conducts 25 per cent of all industrial R&D. This accounts for 20 per cent of the total sales of the U.S. aerospace industry. (See Table 17)

The importance of research and development to the indus-

Table 17. U.S. Industrial Research and Development; All Industries and the Aerospace Industry 1960 to 1975 (Billions of Dollars)

Year	All Industries R & D	Aerospace Industry R & D Total	Government	Private	Aerospace Sales
1960	10.5	3.5	3.2	.4	17.3
1965	14.2	5.1	4.5	.6	20.7
1970	18.1	5.2	4.0	1.2	24.9
1975	23.5	5.7	4.5	.2	28.4

Sources: Compiled from National Science Foundation, Research and Development in Industry, Washington, D.C., 1967, 1973, 1975.

try is also portrayed by the structure of employment. As of 1976, the U.S. aerospace industry employed 19 per cent of all scientists and engineers in the country. At the peak of the industry in 1965, it employed 29 per cent of the total. (See Table18)

Table 18. Employment of Scientists and Engineers for Research and Development in the U.S. 1960 to 1975 (As of December 31 of each Year)

Year	Tatal	Aerospace	Aerospace/Total (%)
1960	292,000	72,400	24.8
1965	343,600	99,200	28.9
1970	384,100	92,600	24.1
1975	360,400	67.600	18.8

Source: Compiled from National Science Foundation, Research and Development in Industry, Washington, D.C., 1967, 1973, 1975.

This concentration of scientists and engineers in the industry is understandable since the growth of the industry totally depends upon its technological capability. More than most industries, the aerospace industry's sales have directly resulted from its research and development activity. Much of industrial research and development activities, however, focused on product improvement and applied areas. Thus most of the basic research and high risk - high cost activities in the aerospace area have to rely upon government finance. In this regard, the U.S. aerospace industry is in a very fortunate situation. About 80 per cent of aerospace research and development is funded by the Federal Government. This is 20 times the proportion that the British aerospace industry is assisted by the British Government.[21]

Table 19 shows the the trend in expenditure the U.S. aerospace research and development and that of Britain. It seems inevitable that with such a tremendous edge in public expenditure on research and development, the U.S. aerospace industry would surpass its British counterpart. However, one should also note that the proportion of the U.S. aerospace research and development expenditure to that of the total industry is steadily decreasing over time. This trend was noticeable since 1969 when the U.S. aerospace research and development expenditure actually decreased. Consequently, the productivity of the industry stabilized.

Table 19. Research and Development Expenditure in the U.S. and Britain 1956 to 1975 (Billions of Dollars)

Year	U.S. Total	U.S. Aerospace	British Aerospace	British Total
1956	6.6	2.2	N.A.	.8
1960	10.5	3.5	.3	1.8
1965	14.2	5.1	.3	2.6
1070	18.1	5.2	.2	2.6
1975	23.5	5.7	.5	N.A.

Sources: Compiled from, Central Statistical Office, Annual Abstract of Statistics, 1955-1976, Her Majesty's Stationery Office, London; Aerospace Industries Association of America, Aerospace Facts and Figures, Washington, D.C., 1959, 1963, 1977.

Owing to the spurt of technological advancement, aerospace exports increased not only in terms of absolute amount but also in relative proportion to total export. (See Table 20) In particular, the proportion of the aerospace exports to the U.S. net balance of trade becomes increasingly important as the balance of trade deteriorates. As a matter of fact, the national interest of monopolizing a superior weapon system and that of earning valuable foreign exchange have been constantly conflicting with each other. So whenever the balance of trade position gets weak, the latter position becomes stronger, and vice versa. This conflict is inevitable since aerospace exports in 1976 accounted for 45 per cent of all shipments by the U.S. aerospace industry and provided 170,000 full-time jobs according to the U.S. Commerce Depart-

Table 20. U.S. Total Exports and Aerospace Exports 1946 to 1975

Year	(A) Total Exports	(B)Aerospace Exports	B/A(%)	Aerospace Trade Balance as Percent of U.S. Trade
1946	9.5	.12	1.2	2.6
1950	10.1	.24	2.4	14.2
1955	15.4	.73	4.7	17.4
1960	20.6	1.33	6.5	31.0
1965	27.3	1.47	5.4	24.9
1970	42.6	3.40	8.0	109.3
1975	106.1	7.79	7.3	73.2

Sources: Department of Commerce, Historical Statistics of the U.S., 1976,1956, Aerospace Facts and Figures, Washington, D.C., 1963, 1977, p. 107.

ment statistics. Overall aerospace exports in 1977, valued at approximately $8.4 billion, will be the largest single contributor to the U.S. balance of trade, accounting for $8 billion after offsetting imports.[22]

The most interesting aspect of the aerospace export market is yet to be explained. Once the U.S. aerospace industry attained a comparatively advantageous position in the market, there is no compelling reason to reverse this, for European countries, according to the comparative advantage theory, can benefit most from concentrating in what they are relatively best at. However, the European countries did exactly the opposite of what comparative advantage theory expected them to do. And the result was successful! This suggests that comparative advantage theory is insufficient

Table 21. Productivity in the Aerospace Industries
1960 to 1972
(Constant 1970 U.S. dollars)

Year	U.S.	Britain	France	Germany
1960	16,132	4,129	9,329	N.A.
1961	16,421	4,694	9,123	N.A.
1962	15,088	4,471	9,455	N.A.
1963	15,891	4,637	9,745	N.A.
1964	17,034	5,362	11,314	N.A.
1965	17,591	6,286	10,121	6,597
1966	17,898	6,571	10,906	5,114
1967	18,374	6,264	12,318	10,031
1968	19,280	6,512	11,290	11,144
1969	18,635	6,952	12,023	10,455
1970	21,381	6,409	12,451	13,125
1971	23,329	7,036	13,074	15,485
1972	26,907	6,863	13,946	18,773
1972	27,810	7,045	18,098	23,204

Sources: Compiled from Aerospace Industries Association of America, Aerospace Facts and Figures 1975/1976, Washington, D.C., pp. 9, 123,188; Interavia, May 1969, p. 517, December, 1970, p. 1501 May 1971, p. 513; July 1972, p. 751; June 1975, p. 616; September 1975, p. 952; September 1976, p. 825; British Industry Today, Aerospace, H.M.S.O., London, 1972, pp. 5-7.

at best, in explaining the behavioral patterns of the aircraft industry in foreign trade.

Table 21 shows the productivity of the aerospace industries in four countries. Productivity is defined in terms of the total real industry sales divided by the total employment of the industry of each country. This indicates that the productivity of the U.S. aerospace industry is the highest among the four. However, this also points out that the productivity of the French and German aerospace industry increased faster than that of the U.S. aerospace industry.

Table 22. Research and Development Expenditures 1961 to 1973 (Billions of Dollars)

Year	U.S.		France		West Germany		Britain	
	R & D	Public (%)	R & D	Public (%)	R & D	Public (%)	R & D	Public (%)
1961	14.6	66	1.0	64	1.8	45	1.8	58
1963	17.4	72	1.3	64	1.4	49	2.2	54
1966	22.3	68	2.2	70	2.2	49	2.6	52
1970	26.9	55	3.2	70	3.0	47	2.7	51
1973	30.6	55	6.0	70				

Sources: Compiled from UNESCO, Science Policy and Organization of Research in the Federal Republic of Germany, p. 58; Science Policy News, January 1970; Science News, 1970; OECD, A Study of Resources Devoted to R & D in OECD Member Countries in 1963-1964, Paris, 1967/8; U.S. Department of Commerce, Statistical Abstract of the U.S., 1962, 1964, 1967, 1971, and 1974.

This may be explained by the fact that the growth rate of the U.S. government R&D funding has decreased from 9 per cent to one per cent annually since 1966 while that of France experienced about 13 per cent and West Germany 30 per cent.[23] (Table 22 exhibits the trend of the research and development of key countries) From this table we can see that France with the largest proportion of public funding on R&D achieved significant increment in productivity. West Germany attained a better performance with least public commitment due to the efficient private sector. Nevertheless, this is because of the more rapid increase in private funding on R&D rather than a decrease in public funding.

Table 23 conforms a consistent relationship between the growth rate of R&D expenditure and that of productivity in four countries. R&D elasticity was used as a measure of efficiency by dividing the former by the latter during the nine year period. Understandably, the U.S. being the explorer in many frontier areas has low elasticity and the West Germany the highest benefiting from already proven technology. The unusually low figure for France, however, is due to a sudden spurt of R&D expenditure in the last few years of the period. (See Table 22)

Table 23. Average Annual Growth Rates of R&D Expenditure and Productivity in Four Countries 1963 to 1972 (in Percentage)

Year	U.S.	Britain	France	West Germany
R&D	5.9	3.0	16.5	11.3
Productivity	6.5	4.5	7.5	19.5
R&D Elasticity	1.10	1.50	0.45	1.73

Sources: Compiled from U.S. Department of Commerce, <u>Statistical Abstract of the U.S.</u>, 1962, 1964, 1967, 1971, and 1974; <u>Interavia</u>, May 1969, December 1970, May 1971, July 1972, June 1975; <u>Science Policy News</u>, January 1970; <u>Science News</u> 1970; <u>Aerospace Facts and Figures</u>, 1975.

As the productivity of the U.S. aerospace industry declined relative to the European countries, the U.S. market-share of the world market declined. In 1960, the U.S. accounted for 86 per cent of the total market. (See Table 24) If the projections are realized, that share will drop below 60 per cent by 1985. At the same time, the European marketshare would increase from 11 per cent of the total market of $18.4 billion in 1960 to 31 per cent of $52 billion in 1985.[24]

Table 24. World Market for Aerospace Products 1960 to 1985

Year	Total Market ($ billion)	U.S. Market-share (%)	European Market-share (%)
1960	18.4	86	11
1964	23.1	82	14
1970	27.9	80	15
1975	35.3	68	25
1980(a)	45.4	65	27
1985(a)	52.0	60	31

Source: Aviation Week and Space Technology, New York, McGraw Hill Co., June 6, 1977, pp. 82-83.
(a) Market Projection Figures

This implies that the European aerospace industry does not necessarily conform itself to comparative advantage theory in setting a developmental strategy. This is so because the comparative advantage itself is not a key element of foreign trade nor an active factor in the economic behavior of both the government and the industry. It is simply a symptom and a result of the economic and political realities. Only real factors (public policy and the industry's creative responses in this case) can change the realities and thus the symptoms. Although there seems to be some relationship between the symptoms and the concerned phenomena, this is only so on the surface. The above observation does not necessarily apply to every industry nor to every economy. But this has been so in the case of the aerospace industries in the U.S. and Western Europe. The argument, presumably, may be extended to other countries with sufficient skilled manpower and firm determination to develop their own high-technology industrial base.

4. GOVERNMENT FINANCING AND TAX POLICY

Traditionally, there are four ways to raise capital for a corporation; retained earnings, debt financing, equity financing, and depreciation allowance. Profit levels, however, direct all of these in one fashion or another, since both the cost of capital and the size of capital which the corporation can raise directly or indirectly depends upon profit. In the case of the aerospace industry, the profit level is determined by public policy in various ways since an appreciable portion of sales are generated by the government; while still more of the non-governmental sales, such as the military aerospace exports, are directed by government. (See Table 25) Therefore profit policy set by the government affects cost of the capital so profoundly that it does not make any sense at all to look into the industry's behavior without looking into this matter.

Table 25. Sales of Major U.S. Aerospace Companies by Customer 1950 to 1975
Billions of Dollars
(Percentage in Parenthesis)

Year	Total	U.S. Government	Other
1950	3.1	2.6 (84)	0.5 (16)
1955	12.4	10.5 (85)	1.9 (15)
1961	14.9	11.8 (79)	3.2 (21)
1965	17.0	12.5 (74)	4.5 (26)
1970	24.8	16.4 (66)	8.3 (34)
1975	29.2	17.2 (59)	12.0 (41)

Sources: Bureau of the Census, Current Industrial Reports, Series MQ 37D; Aerospace Industries Association of America, Aerospace Facts and Figures, 1976/1977, Washington, D.C., 1977.

In this regard contrasting features of the profit policy of the U.S. and that of Britain offers outstanding opportunity to assess the impact of public policy on corporate finance and subsequential performance. Overall prospects of profit for the U.S. aerospace industry have been more favorable than that of the European countries, particularly of Britain. This stems from contrasting approaches used to determine contractor fees for negotiated defense contracts. The U.S. system bases the target contract profit on the characteristics of the inputs furnished by the contractor and other features of the contract. On the other hand, the British system computes the contract profit rate according to return on assets, adjusted for other features of the contract. These two different policies of profit computation have a crucial impact on entrepreneurial motivations.

a. THE U.S. PROFIT SYSTEM

The U.S. system offers flexibility of differentiating among different types of inputs. Thus through its profit policy the government can encourage contractors to acquire certain skills and capabilities and discourage them from acquiring others. For instance, the contractor can improve profit by performing tasks which require relatively large amounts of engineering work.[25]

In the U.S. system, profit determination consists of two steps. First, the target cost of the contract is determined by applying cost analysis principles. Second, a target profit rate is determined by multiplying these two figures.

The base to which the profit rate is applied is obtained by estimating the expenditures required to fulfill the contract. Direct costs have to be both "allocable" and "allowable," as defined in the Armed Service Procurement Regulation.(ASPR) Indirect cost is reimbursed based on a set overhead rate. This determination of the target cost is governed by a number of complex and controversial cost principles, which sometimes exclude from allowable cost outlays commonly regarded as ordinary business expenses.[26]

The profit rate applied to the cost base is determined by a system called weighted guidelines(WGL). The first component of the profit rate is based upon the characteristics of the inputs which the contractor furnishes. The formal designation of this component is Contractor's Input to Total Performance. This portion of the fee is designed to discourage profit pyramiding, which is earning excessive profits through the cost of items produced hy subcontractors. It also encourages firms which use engineering labor and other specialized skills. Accordingly, the Input to Total Performance factor results in a higher profit rate for firms engaged in sophisticated in-house activities relative to firms doing a large amount of subcontracting.

The second component of the profit rate consists of several factors (or below the line factors) that reflect the degree of cost risk, the past performance of the contractor and the "selected factors." The most important factor is the degree to which the Contractor relies on Government facilities. To compute the Contractor's Input to Total Performance, the total estimated cost is divided into eight catagories; direct material, engineering labor, manufacturing labor, special tooling, engineering burden, manufacturing burden, general and administrative expenses, and royalties. The ASPR specifies a range of profit rates for each factor. The contracting officer selects from within these ranges specific profit rates. The rates are multiplied by the estimated cost allocated to each expense category. This multiplication yields a profit on each expense category. Adding up this profit and dividing it by the estimated cost yields the basic target rate up to a maximum of 7 per cent.[27]

This rate is then modified by the "below the line" factors. The risk factor depends upon the type of contract, the reliability of the cost estimate, and the difficulty of the contractor's task. Put differently, risk, for profit purposes, is essentially defined by the pricing arrangement and the method of source selection. Allowance for the past performance is designed as an incentive for efficiency and high quality work. It can increase or decrease the profit rate by as much as two percentage points.

The "selected factors" can result in the subtraction of up to two per cent from the profit rate. The most important consideration here is the amount of Government furnished facilities and equipment used. A firm with no such facilities would have no subtraction, but a firm with extensive use of such facilities could penalized by the subtraction of two percentage points. This is used to motivate contractors to invest.

The main determinant of the profit rate in the U.S. system is the nature of the underlying cost base. Thus a firm with substantial inputs of direct labor, particularly engineering labor, will have very high target profit rate. On the other hand, a very capital intensive firm using small amounts of "unsophisticated" labor skills will have relatively low profit rates. Converting these rates of return on the cost base to rates of return on assets, the former firm will earn a higher profit rate on its investment compared to the latter firm.

However, the Department of Defense(DOD) policy is not the only factor which affects the profit level of the industry. The Renegotiation Board which was originally established as an independent agency to control general price-wage-profit levels during the World War II is directly responsible. Renegotiation has been maintained on the rationale that it permits contract prices to reflect the change in any production condition which was unforeseen when the contract was negotiated. Thus the Renegotiation Board is primarily engaged in backstopping the contracting process by providing an opportunity for a retrospective view of the costs upon which the prices were based.[28] The Board, nevertheless makes no attemptes to determine an appropriate rate of return on capital. It simply judges the application of each of the statutory factors enumerated above to the facts of the following cases:

1. reasonableness of costs and profits,
2. net worth, particularly the amount of Government furnished plant and equipment,
3. risk assumed,
4. nature and extent of contribution to the defense effort,
5. character of the business,
6. other factors the Board may adopt.[29]

Therefore, DOD procurement policy remains the main framework of computing profits which affects the financial structure of the U.S. aerospace industry directly and indirectly.

The U.S. system, however, does have some weak points. One of these is the inadequate, and indirect treatment of the contractor's investment. The only explicit allowance for the contractors investment is the penalty leveled against firms utilizing Government-furnished facilities. Profit policy does not distinguish between the capital intensive work and the labor intensive work. Thus the U.S. system discriminates aginst capital intensive firms. This has not been much of a problem for the large aerospace companies since they are all relatively labor intensive. (See Table 26) Many of the subcontractors which are classified as other manufacturing industries, however, are engaged more in manufacturing than in assembly and integration, and are therefore more capital intensive.

Table 26 Assets Per Employee Among the 500 Largest Industries in the U.S.

THE INDUSTRY MEDIANS	
Petroleum refining	$196,927
Mining, crude-oil production	114,898
Broadcasting, motion-picture	70,434
Beverages	69,026
Tobacco	65,298
Metal manufacturing	57,272
Chemicals	54,212
Paper,fiber, and wood products	47,587
Pharmaceuticals	40,923
Soaps, cosmetics	36,885
Publishing, printing	36,468
Food	36,463
Industrial and farm equipment	33,893
Shipbuilding, railroad equipment	33,705
Glass, concrete, abrasives, gypsum	32,780
Metal products	30,625
Office equipment	30,112
Motor vehicles	29,754
Rubber, plastic products	28,913
Scientific equipment	28,838
Electronics, appliances	25,239
* Aerospace	23,954
Textiles, vinylflooring	21,254
Apparel	14,991
Toys, sporting goods	N.A.
Leather	N.A.
Furniture	N.A.
Jewelry, silverware	N.A.
All Industries	37,939

Source: Fortune, May, 1976.

The administrative advantage of the U.S. system is that the government can avoid explicit decisions about the net profit requirements for specific firms. This, however, necessarily works aginst economizing the cost of defense contracts. Nevertheless, from the industry's point of view this is the most advantageous for capital accumulation.

b. THE BRITISH PROFIT SYSTEM

The British defense profit system regulates the rate of return on the original cost of assets in a manner similar to that of the public utility and transportation industries in the U.S. This system requires three separate decision stages:

1. the composition and value of the asset base,
2. the appropriate target rate of return to be applied to the asset base,
3. a set of contract profit rates that could yield the required profit.

The British system uses an original cost, less depreciation approach. However, certain corporate assets are usually excluded. For instance, good will, investments in stocks and securities, excess cash, and loans to subsidiaries are excluded from the computation of the assets base.[30]

In converting target profits of investment to a target rate of return on contracts, the British system views the firms as a single unit. Thus the precise rate of return on the capital devoted to any particular contract is not calculated. Then turnover ratio is obtained through dividing the contractor's assets, by total cost of production for the previous year. Multiplying this by the target rate of return on assets yields a target rate of return on contract cost without determining an asset rate base for each contract.[32]

Since the capital intensities of various projects differ, a firm will make more than the target rate of return on some assets and less on others. Also, if the turnover ratio in a given year differs from that of the previous year, then the actual rate of return on assets will differ from the target. If the firm has more sales than expected, the actual rate of return on assets will be greater than anticipated. If turnover is less, profits will also be less. In other words, the British profit system is based on computation of a turnover ratio and the actual profits will depend upon the degree to which the sales expectations are fulfilled. Thus actual profit tends to diverge from the target rate of return. This also makes profit rates of the British industry lower than that of its U.S. counterpart since the aerospace industry is not a capital-intensive industry. (See Table 27)

Under the British system, the industry is encouraged to invest more plant and equipment than the U.S. system which relates fee to the total cost. On the other hand, the U.S. aerospace industry has more room for profit since the target profit is computed on the basis of cost which is easier to inflate than asset base. Consequently, overall profit rate of the U.S. industry has always been better than that of British industry. Table 28 exhibits the trend of the aerospace industry's rate of return on net assets in both countries.

Table 27 The Aerospace Industry's Rate of Return on Net Assets in the U.S. and Britain (in percentage)

Year	U.S.	Britain
1956	35	19
1957	31	16
1958	23	13
1959	14	11
1960	10	9
1961	14	6
1962	18	7
1963	17	9
1964	18	6
1965	23	N.A.
1966	20	N.A.
1967	16	N.A.
1968	18	N.A.
1969	13	N.A
1970	7	N.A.
1971	6	N.A.
1972	9	N.A
1973	11	N.A
1974	11	N.A.
1975	10	N.A.
1976	13	N.A.

Sources: Compiled from Aerospace Industries Assciation of America; Aerospace Facts and Figures, Washington, D.C., 1963, pp. 80-3, 1968, pp. 92-93, 1972/1973, pp. 104-105, 1977/1978, pp. 131-132, and Plowden Report, London, Her Majesty's Stationery Office, 1965.

No comprehensive industrial data are available for British industry since Plowden Report came out in 1965.

This low profit rate along with small procurement made the British industry incapable of accumulating the necessary capital base. Ultimately, this led to the nationalization of the British aerospace industry. Reflecting back, it would have been much wiser and economical for Britain to allow sufficient profit in order to develop its aerospace industry internationally rather than to make it so lean that ultimately the government would have to bear the whole burden.

5. EXPORT POLICY AND EXPORT PATTERN

Government influence upon the export promotion of aerospace products is something of a myth throughout recent history. However, we can gain some understanding of its essence through a few publicized facts.

Traditionally, the U.S. has considered Latin America as the arena of its influence. Thus, when Israel tried to export Kfir (Young Lion) to Equador, the U.S. official reaction was one of anger. The U.S. turned it down on the basis of an agreement on the sales of supplies (particularly that of General Electric J-79 engines) that Israel required permission from the U.S. in order to export to a third country.[33] Furthermore, the U.S. began to treat Israel Aircraft Industries(IAI) as a tough, prospective competitor in the world market. Accordingly, getting license arrangements with the U.S. aerospace companies became extremely difficult.[34]

Sensing the international position of the U.S., the British government has intentionally avoided confronting the U.S. aerospace industry in this sensitive market. In any case, after World War II, Britain was not in a position to vex the U.S. by exporting arms to the Third World. The same was true of West Germany, Japan, and Italy. France under General de Gaulle was probably the only country which was able and willing to do so. This left the U.S. aerospace in a virtually monopolistic position in the world market for military aircraft.

With the Kennedy Administration, in 1961, the Pentagon was swiftly changed by the personality of the new Secretary of Defense, Robert McNamara. He, with a Ford Motor background, was determined to run the Pentagon in a business-like fashion. So he attempted to standardize weapon systems not only domestically but internationally, in particular among the NATO countries. For instance, the NATO countries employed fourteen different types of small-arms and ammunition, while the Communist block used one.[35] In the process of standardization, he insisted on unifying the system with that of the U.S. since American arms were the most advanced and the most economical with the biggest domestic market.

Second, the Kennedy Administration was deeply worried about the deficit in balance of payments, which amounted to $3 billion.[36] At the beginning of his presidency, Kennedy told the NATO allies that they must pay for their arms. During 1961 a task force headed by McGeorge Bundy and Paul

Nitze investigated the problem and decided to set up a special group inside the Pentagon. It was called the International Logistics Negotiations(ILN), but it was actually an organization for selling arms.[37]

It was now that the government was urging the industry to sell. The ILN, persuaded foreign governments to buy arms, and the U.S. companies to sell them. Soon the U.S. was selling an average of $2 billion in arms each year. This was more than twice the value of the arms given away in grant aid.[38] The aerospace products amounted to more than 60 per cent of the total arms exports.[39]

The Northrop Corporation is a good example of direct governmental support for export promotion. In 1968, its contract to produce T-38 trainers for the Air Force was about to expire. The Freedom Fighter, a fighter version of T-38, was becoming harder and harder to market overseas due to its limited range and speed. By some means, Congressman Rivers, then chairman of the House Armed Service Committee, persuaded the Pentagon and Congress to appropriate $28 million for improving the fighter.[40] Furthermore, the Pentagon placed an initial order of 325 F-5Es or International Fighters in order to set the project in motion.[41]

Gradually this new improved fighter gained the reputation of being the most economical fighter in the world. It is reputed to be a match for a MIG-21 in combat. Yet, with a fly-away cost of $2 million, it costs less than any other modern supersonic fighter in the world.[42] International Fighters have been exported to twenty-two countries including Switzerland, Canada, Korea, and Norway. In Washington it was regarded as a key instrument of foreign policy providing links with the Third World. It has thus contributed $2 billion to the U.S. balance of payments. So the F-5E became the most successful arms export for the U.S. since McNamara's doctrines of selling arms rather than giving arms was initiated.[43]

If the case of Northrop was due to the success of the overt governmental promotion of an aerospace export, then the case of General Dynamics is a brutal battle among the Allies, in particular, the U.S. and France. This stems from the urgent need for standardization in employing a replacement for the F-104, the Starfighter. However, this time the role of the government was more active and the pressures and lobbying came as much from diplomatic and defense officials as from the companies. The concerned governments decided that the matter was too crucial to be left to the hands of the aerospace tycoons because the choice would affect not only the future of aerospace industry, but the political character and the development of Europe.

Originally, there were six contenders: BAC, Hawker

Siddeley, French Dassault, Swedish Saab, Northrop, and General Dynamics. But soon it became apparant that this was a battle between Dassault and General Dynamics as it was finally rewarded the U.S. Air Force contract in 1975 with the eventual prospect of orders for 650 planes.[44]

General Dynamics, however, was slow in getting into the international market. Secretary of Defense Schlesinger, determined to press for standardization, urged the company into battle, promising the full weight of the Pentagon behind them.[45] For the first five months of 1975 the contest for the NATO plane was at its peak. The Swedes offered tempting offset agreements and the French Government suggested the future integration of the whole European aircraft industry. The French government also assured other countries that France would be thoroughly integrated with NATO.[46]

General Dynamics promised the Europeans a share in the profits and production of any planes sold to the Third World, which they estimated to be about two thousand planes. At the same time, the Pentagon overtly supported the company by reminding them that unless NATO is standardized, the future of the U.S. defense of Europe would be in jeopardy. President Ford personally discussed the matter with Belgian Prime Minister when he visited Brussels for a NATO meeting.[47]

At last, in May 1975, Holland, Norway. and Denmark agreed to order the General Dynamics' F-16. The Belgians were still split because of the delicate political situation existing between the Walloons and the Flemish. Then Schlesinger invited the Belgian Minister of Defense to Washington and pointed out that the four countries would probably get back their whole initial investment by producing more planes for the Third World. He also offered to buy $30 million worth of Belgian machine-guns, which are made in French speaking Belgium.[48] Finally on June 6, Belgium announced the decision to buy the American plane. The Europeans paid for American technology, contributing as much as half-a-million dollars to the development costs of each plane.[49]

These anecdotal examples demonstrated the importance of the role of the government in exporting aerospace products. This does not mean, of course, that the technological factors are not important. Nevertheless, the influence of public policy overshadows the remaining factors which may have some influence over the decision making. In the real world of politics, some influence may be only as good as none.

This active export policy along with other public policy changed the pattern of the U.S. foreign trade substantially during the last half a century. Table 28 exhibits the export structure of key commodities in the U.S. during the period from 1910 to 1975. In the pre World War I period, cotton export comprises 58 per cent of the total export of eight

Table 28. U.S. Export Pattern of Key Commodities
1910 to 1975
Millions of Dollars
(Percentage in Parentheses)

Year	Raw Cotton	Leaf Tobacco	Wheat	Meat	Auto	Petro-leum	Iron Steel	Aero-space	Total
1910	450	38	48	62	11	107	60	-	776
	(58)	(5)	(6)	(8)	(1)	(14)	(8)	-	(100)
1920	1136	245	597	279	303	593	498	1	3,652
	(31)	(7)	(2)	(8)	(8)	(16)	(14)	-	(100)
1930	497	145	88	66	279	495	139	9	1,718
	(29)	(8)	(5)	(4)	(16)	(29)	(8)	(0.5)	(100)
1940	213	44	11	22	254	310	516	312	1,682
	(13)	(3)	(1)	(1)	(15)	(18)	(31)	(19)	(100)
1950	1024	250	405	43	723	499	472	242	3,658
	(28)	(7)	(11)	(1)	(20)	(14)	(13)	(7)	(100)
1960	980	379	1029	84	1270	468	635	1330	6,175
	(16)	(6)	(17)	(1)	(21)	(8)	(10)	(22)	(100)
1970	372	481	1112	147	3245	488	1188	3397	10,430
	(4)	(5)	(11)	(1)	(31)	(5)	(11)	(33)	(100)
1975	991	853	5293	491	8192	907	2382	7792	26,901
	(4)	(3)	(20)	(2)	(30)	(3)	(9)	(29)	(100)

Sources: Compiled from U.S. Department of Commerce, Bureau of Census, Historical Statistics of the U.S., Colonial times to 1958, Washington, D.C., 1960, p. 546; Ibid, 1975, and Statistical Abstract of the U.S., Washington, D.C., 1976.

key commodities. But in 1975, it consists of only 4 per cent of the total while aerospace export increased from less than 1 per cent in 1920 to 29 per cent of the total.

One thing to note is that real price of cotton steadily decreased during the period. Thus if the U.S. relied on cotton export which was comparatively advantageous, its foreign exchange earning power would have been greatly deteriorated. From the British point of view, it would have been much better if the U.S. concentrate on agricultural production with its vast fertile land while she specialize on high technology - high unit value industry such as aerospace. Considering this, it is not surprising that the most ardent advocates of comparative advantage theory have been produced by Britain.

6. GOVERNMENT PROCUREMENT POLICY

Of the many factors which differentiated the performance of the U.S. aerospace industry from that of its British counterpart is the size of government procurement. Size is a crucial factor in improving productivity and cost reduction in the industry because of its consequential learning effect. The phenomenon of learning in the manufacturing process first attracted serious attention during World War II.[50] Since then it has become an increasingly familiar concept particularly in the aircraft industry.

In any type of work as workers become familiar with the peculiarities of a new job through repetition, the time they take to accomplish it progressively decreases. Progressive improvement in method also contributes to cost reduction. Thus a learning curve can be derived by plotting the man-hours required to produce a unit against quantity.

It shows that for each increment in the quantity produced, there is a corresponding percentage reduction in man-hours per unit. For a typical airframe construction, if the first unit requires 1,000 man-hours, the time required by successive units will be as shown in the following table.

Table 29 Man-hours on a Typical Learning Curve in Aircraft Production

Number of unit	Man-hours per unit	Cumulative average Man-hours per unit
1	1,000	1,000
2	800	900
3	702	834
4	640	785
5	596	748
10	477	631
20	381	524
30	335	467
40	305	430
50	284	402
100	227	327
200	182	264
300	159	232
400	145	212
500	135	198
1000	108	159

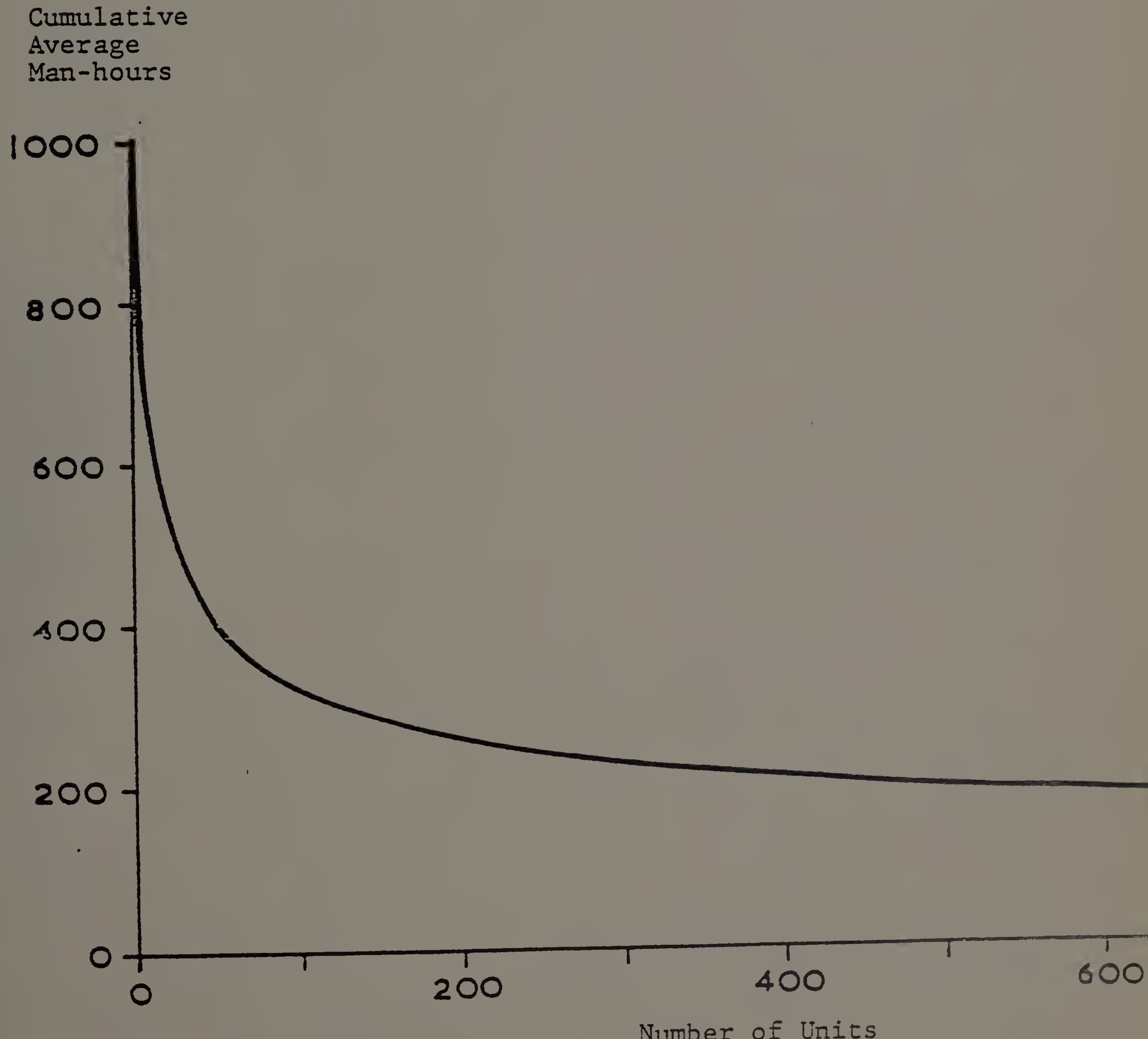
Source: Ministry of Technology, Productivity of the National Aircraft Effort, London, Her Majesty's Stationery Office, 1969.

As man-hours for successive units decrease, so does the average hours for all units produced, as column 3 of Table 29 shows. The decrease in the unit and cumulative average man-hours is most notable in the smaller units stages. As the number of units produced increases the productivity improvement gradually becomes smaller and smaller. This is shown more clearly when the learning curve is plotted as in Graph 3. Consequently, when we compare productivity it makes a great difference whether we are referring to the production of 10 units or 1,000 units.

With regard to the number of units produced the U.S. and Britain are incomparable. In 1976 the U.S. aerospace industry delivered 16,605 units while its British counterpart delivered only 353 units.[51] This is mainly due to the contrasting size of defense procurement of the respective governments. As the following Table 30 indicates, the defense budget of British government is a fraction of that of the U.S. However, it should be stressed that there are at least three different official sources of statistics on the aerospace industry and all three are consistently inconsistent to each other. The three are Business Monitor, a British government statistical publication, Department of Industry and the Society of British Aerospace Companies. What is more, the Annual Abstract of Statistics, published by Central Statistics Office, further confuses the situation. Thus, as a compromise median number of the two extremeties was chosen as a representative number.

From Table 30 we can see that the size of British

Graph 3. Learning Curve in Aircraft Production



Source: Ministry of Technology, Productivity of the National Aircraft Effort, London: Her Majesty's Stationery Office, 1969.

Table 30. The Proportion of Government Procuremant to the Aerospace Industry Sales in the U.S. and Britain 1960 to 1976 (Billions of Dollars)

Year	Britain			U.S.			British/U.S. Procurement (%)
	Industry Sales	Government Procurement	%	Industry Sales	Government Procurement	%	
1960	1.2	.5	44	17.3	13.6	79	4
1961	1.4	.6	43	18.0	14.5	81	4
1962	1.3	.6	48	19.2	15.7	82	4
1963	1.3	.6	47	20.1	16.8	84	4
1964	1.4	.6	43	20.6	17.9	87	3
1965	1.6	.6	38	20.7	15.9	77	4
1966	1.6	.6	35	24.6	18.3	74	3
1967	1.6	.5	32	27.3	20.1	74	3
1968	1.6	.5	31	29.0	21.4	74	2
1969	1.7	.4	26	26.1	20.5	79	2
1970	2.2	.4	19	24.9	18.7	75	2
1971	2.5	N.A.	N.A.	22.2	15.3	69	N.A.
1972	3.0	.9	29	22.8	15.9	70	5
1973	3.8	1.3	N.A.	24.8	15.3	62	8
1974	N.A.	1.8	N.A.	26.4	15.2	58	12
1975	N.A.	1.9	N.A.	28.4	15.9	56	12
1976	N.A	2.4	N.A.	29.3	16.2	55	15

Sources: Compiled from British Industry Today; Aerospace, London, 1972, Her Majesty's Stationery Office, Annual Abstract of Statistics, 1976, Interavia, September 1975, and Aerospace Industries Association of America, Aerospace Facts and figures, 1977/78, Washington, D.C., 1977.

government's procurement is about 3 per cent of that of the U.S. government. However, this has changed in the 1970's since the U.S. government procurement substantially decreased. It is also noticeable that the U.S. aerospace industry is twice as dependent upon government procurement as the British aerospace industry. This indicates that

Table 31. The Proportion of Export to the Industry Sales of the U.S. and British Aerospace Industries 1960 to 1975 (Billions of Dollars)

Year	Britain			U.S.			A/B (%)
	Total Sales	(A) Exports	Export/ Sales(%)	Total Sales	(B) Exports	Export/ Sales(%)	
1960	1.2	.4	34	17.3	1.7	10	23
1961	1.4	.4	31	18.0	1.7	9	25
1962	1.3	.3	26	19.2	1.9	10	17
1963	1.3	.2	20	20.1	1.6	8	15
1964	1.4	.2	18	20.6	1.6	8	15
1965	1.6	.4	26	20.7	1.6	8	26
1966	1.6	.5	32	24.6	1.7	7	31
1967	1.6	.5	30	27.3	2.2	8	22
1968	1.6	.7	45	29.0	3.0	10	23
1969	1.7	.7	44	26.1	3.1	12	24
1970	2.2	.7	31	24.9	3.4	14	20
1971	2.5	.9	34	22.2	4.2	19	20
1972	3.0	1.1	37	22.8	3.8	17	29
1973	3.8	1.5	39	24.8	5.1	21	30
1974	N.A.	1.8	N.A.	26.4	7.1	27	26
1975	N.A.	2.3	N.A.	8.4	7.8	27	30
1976	N.A.	N.A.	N.A.	29.3	7.9	27	N.A.

Sources: British Industry Today; Aerospace, Her Majesty's Stationery Office, London, 1960-1976, Annual Abstract of Statistics, London, Her Majesty's Stationary Office, 1960-1976, Interavia, September 1976, Aerospace Industries Association of America, Aerospace Facts and Figures, 1977/1978, Washington, D.C., 1977.

the British industry depends more upon the exports. Table 31 shows the proportion of exports to the industry sales of both countries. This demonstrates that the Britain has been forced to sell arms to arm her own forces because of the small size of government procurement. Table 31 also indicates that the U.S. aerospace industry is increasingly dependent upon export sales while the proportion of government procurement is steadily decreasing as was indicated in the previous table 30. At the same time, the relative market position of the British aerospace industry compared to the U.S. aerospace industry has improved.

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CHAPTER V. SUMMARY AND CONCLUSION

1. OBJECTIVE OF STUDY

The Heckscher-Ohlin theorem assumes that comparative advantage causes and determines the pattern of international trade.[1] But is comparative advantage really a cause of international trade or is it just a result of it? Or are both international trade and comparative advantage the result of something else? Although this causality has been taken for granted due to its intuitive appeal, the implication of the causation can hardly be exaggerated since the future pattern of trade and the developmental strategy of any economy will depend upon it.

In a state of global inflation, only an industry with the inelastic price elasticity of demand for its product can raise the relative price level of its product sufficiently to improve the real income. Therefore, only an economy with a high technology - high unit value industrial base can better the income and employment levels of its people through export expansion. Accordingly, only in this sense, can export be truly an 'engine of growth'.[2] The theory of comparative advantage, however, directs an economy to concentrate on an industry which it is relatively best at. This leads to wider gap between a developed economy and a developing one by further reinforcing the state of comparative advantage.

If comparative advantage theory were right, the prewar U.S. would have been better off by remaining a predominantly agricultural economy indefinitely while Britain concentrated on technology-intensive industry such as the aircraft industry. But the U.S. aircraft industry took the opposite course. This diffiance of the U.S. aircraft industry and government turned out to be the cornerstone of American leadership in the postwar period. Again Europe in the 1970's took a similar action in the development of the aerospace industry. All these contradict what comparative advantage theory has put forth for the last two centuries.

The basic objective of this study is to critically examine the export pattern of the U.S. aerospace industry in light of international trade theory to substantiate that the real driving force of international trade is not comparative advantage but the concerted will of entrepreneur and government to expand the market, thus improving the productivity and the income level. In the process of determining what to export, an industry with a high potentiality of earning power and a high strategic value in a politicoeconomic sense, has a high priority.

Once the export is determined, the state of comparative advantage is changeable through various public policies. This is why comparative advantage seems to dictate the pattern of international trade on the surface. In reality, however, comparative advantage is only a result of the interaction between public policy and the entrepreneurs adaptability to a changing economic reality.

In a passive economy dominated by the trade of crude commodities, comparative advantage seems especially fixed and vested. But in the complex world we live in today, this is more determined by public policy than a passive factor endowment which was stressed so much by the comparative advantage advocates since factor endowment can be changed by public policy. For example, a $20 million jet fighter is nothing more than seven tons of steel and aluminum plates which would probably cost less than one thousandth of its price. Would natural factor endowments affect the state of comparative advantage? Even other factors such as capital and skilled labor are changeable by the public policies of resource allocation and systematic training. A generally capital deficient economy can have a capital intensive industrial base by concentrating its resources. Thus it does not make any more sense to analyze international trade through factor endowments than to judge a human being in terms of his height.

All these factors lead to the hypotheses of this study:

1. The comparative advantage is not a factor which is vested and fixed;

2. The state of comparative advantage is constantly changed by the interaction of public policy and the entrepreneurs' adaptability to their changing economic reality;
3. Comparative advantage is not a sufficient driving force of international trade but a necessary factor resulting from exogeneous efforts;
4. The active driving force of international trade and the determinant of international trade pattern are the wills of entrepreneurs and government to improve the income and employment levels through market expansion.

In order to substantiate these hypotheses, the growth of the U.S. aerospace industry and its export pattern were critically examined in conjunction with U.S. public policy. By doing so this study explore the crucial role of the government in changing the state of comparative advantage between the U.S. and British aerosapce industries.

2. REVIEW OF STUDY

In chapter two, three main lines of thought on international trade were examined; protectionism, price theory, and income theory. Protectionism is by no means a rigorous school. Yet its persistent influence on actual policy making process, suggests that it should not be ignored.

However, the resulting high cost to an economy as a whole in the long run makes it self-defeating.

Price theory begins with Adam Smith's absolute advantage theory. But the real spurt was after the conception of comparative advantage by Torrens and Ricardo. This is further refined by Heckscher and Ohlin into the factor endowment theory. Samuelson and Meade expand Heckscher-Ohlin theory into multi-dimensional model. There are further refinements of the price theory with the introduction of technology, competition, transportation, and economies of scale. Nevertheless, price theory presents only a limited scope of production and cost neglecting demand and income sides.

Income theory is concerned with the multiplier-accelerator effects of income and the balance of trade effects generated by exports. This, however, was insufficient in explaining the widening gap between the income level of a developed economy and that of a developing one which is equally or even more export-oriented than the former. Thus income theory was further ameliorated by the introduction of a terms of trade factor.

Despite all these, contemporary international theory lacks an explanation of the active cause of international trade. This is due to the fact that it deals with the symptoms rather than the actors in economic reality. In the real world, the true actor is Man himself. Consequently, his value system, mentality, physical dimension, and social institutions direct the destiny of the world he lives in. Eventually, these would extend into public policy ranging from foreign policy to tax policy. These policies constantly change the external factors of production and consumption. This study has named this, the dynamic externality theory. Thus, no matter how difficult it is to handle these factors, these must be included in any viable theory.

In chapter three, the growth of the U.S. aerospsce industry from its birth to today was examined. In every stage of breakthrough, various policy measures implemented by the government and the industry's adaptation to it was closely examined.

In chapter four, the impact of public policy on the exports of the aerosapce industry was analyzed from various aspects: research and development, government financing and tax, export, and government procurement policies. For the purpose, the industry data of the U.S. and the Western Europe, especially that of the British aerospace industry were widely used to do a comparative analysis.

From chapter two we learned that international trade theory is based upon comparative advantage. However, this case study suggests that both cost of production and demand, in so far as aerospace industry is concerned, are essentially determined by public policy which is in return determined by the interaction of the value system of people and political institution. As we saw production cost and supply curves are dependent upon public expenditure for research and development, tax policy, and government procurement. At the same time demand itself is grossly determined by public policy since government procurement is more than a half of the total industry sales and export is also directed by the foreign and military policies of the government.

A significant corollary of this is that when the U.S. government supports research and development, and thus improves productivity, the state comparative advantage of the industry and export pattern are changed. Likewise, if an economy concentrate on the limited areas of the industry, it by virtue of specialization may be in a position to compete with the other established economy as the U.S. did successfully with Britain. For example, Israel and Brazil are becoming increasingly competitive in the world market. Also the Western Europe increased its market share through aggressive public procurement and R & D policies.

What they have in common with each other can be summed up as following:

1. Much of R & D activities are funded by the government. In case of the U.S. aerospace industry, it comes up to 79 per cent of the total R & D expenditure;
2. Government directly and indirectly finances the industry by accelerated depreciation allowances, stabilized profit level, government furnished equipments and plants, and various incentive measures for efficient contractors;
3. Government covertly and overtly promotes the export through the agencies of both foreign and military services. This government promotion activities intensify when the balance of payment position is worsen;
4. The size of government procurement is crucial to attain sufficient economies of scale, since government procurement consists 60 to 80 per cent of the total industry sales in case of the U.S.;
5. Government guides the industry through long range planning and coordination, thus keeping the industry as a whole viable.

Therefore, the active public policies of concerned government were indispensable in nurturing high technology industry such as aerospace industry. Also each change in public policy may shift the whole external conditions of supply and demand. Consequently, we should incorporate the various aspects of public policy into our consideration no matter how difficult it may be.

3. CONCLUSION

The hypotheses of this study were:

1. Comparative advantage is not a factor which is vested and fixed;
2. The state of comparative advantage is constantly changed by the interaction of public policy and the entrepreneurs' adaptability to their changing economic reality;
3. Comparative advantage is not a sufficient driving force of international trade but a necessary factor resulting from exogenous efforts;
4. The active driving force of international trade and the determinant of international trade pattern are the wills of entrepreneurs and government to improve the income and employment levels through market expansion.

The above hypotheses were substantiated by the study. These may not be universal, but as far as the aerospace industries in the U.S. and the Western Europe are concerned, the above hypotheses are viable throughout seventy years of their history.

Also other hypotheses were suggested by the study. Such hypotheses deserve further analysis:

1. An oligopolistic industry regulated to secure the public interest of a nation will affect the patterns of foreign trade of potential competitors. The benefits of the trade may or may not be advantageous to the welfare of the affected countries;
2. A small country, by selective specialization, may successfully compete with a larger, better endowed country, if the small country concentrates its efforts in the limited segment of the market;
3. The public policy of an exporting country may persistently affect production conditions of given commodities regardless of the natural endowments of the concerned country. Such adverse effects may result in institutionalized adjustments in trading countries and may radically affect the conceptions of comparative advantage;
4. Natural endowment as a basis for comparative advantage may be grossly affected by the market structure and also by access to government assistance.
5. The benefits of international trade may, by the public policy of a country, accure that country to a greater degree than if comparative advantage were the major determinant of trade.

The implication of this study is that developmental strategy of any economy needs not to be bounded by the present state of comparative advantage. This then opens a whole new horizon of the theory of economic development. Export to be a true 'engine of the growth' export item should be of high technology - high unit value industry. Otherwise an economy heavily relying on low technology - low unit value exports would do nothing but lower the living cost of other economies which concentrate on technology-intensive industries.

This does not mean that every economy should go into every technology-intensive industry. It must be extremely careful in selecting an industry to which a whole economy is to concentrate its resources and manpower. The tactics and criteria of the selection process, however, is beyond the scope of this study.

4. AREAS OF FUTURE STUDY

This study is exploratory. Consequently, to gain further insights into the implementable theory in international trade, this should be extended over more external factors which may be less significant than the ones included here. Also quantification of variables wherever possible with sensibly disaggregate data would enhance the applicability of the study to the policy making process.

Nevertheless, it should be emphasized that every prospective variable must be scrutinized in light of causality. Furthermore, business and economic sciences as a whole should be more concerned with actors rather than symptoms. In other words the economist should not be afraid of tackling the subjective issues involved with ideological controversies. The development of business and economic sciences is characterized by the quantification with value-free variables. This may be partially due to the boisterous idelogical controversies during the last century.

Unlike the physical sciences, however, the social sciences cannot escape from subjectivity since the true actor of social phenomena is Man himself. Thus social scientists should accept a value system as the backbone of the theoretical framework no matter how difficult it is to comprehend. Also institutions, as a social embodiment of Man himself, should be considered as more of a living organism rather than as of a indiscriminative mechanism of variables.

After all, there is no permanent and universal rule or value system in social phenomena, except self-preservation and self-realization. Only this must be permanent and universal. Because the end of it will mean the end of human existence.

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